VOL. 107 • NO. 2781 • PAGES 379-404

April 16, 1948

APR 20 1948

Science

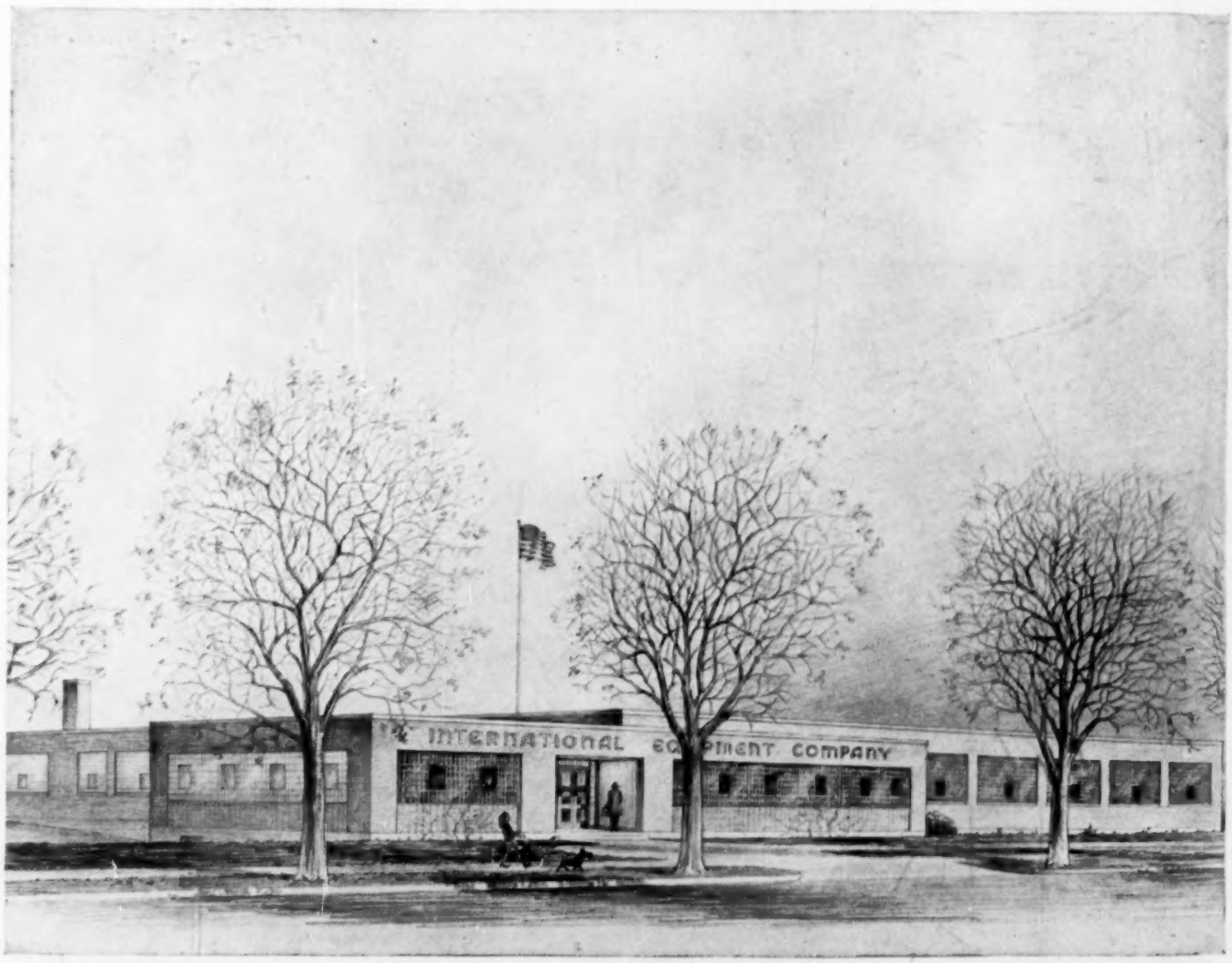
PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

The Passano Foundation Award Winners

(See page 387)

Meeting Our Obligation

Rapidly expanding research on a national basis imposes an obligation on manufacturers of laboratory apparatus and calls for greatly increased production of quality instruments. As our part in this expanding program, we have recently completed construction of this modern factory building. Here, International Centrifuges of traditional quality are now being produced in greater numbers than ever before. In announcing our new address recorded below, we reaffirm our faith in the future of research and pledge the scientist our continued support.



INTERNATIONAL EQUIPMENT COMPANY

1284 SOLDIERS FIELD ROAD, BOSTON 35, MASS.

Some Recommendations of the President's Commission on Higher Education

Alfred B. Bonds, Jr.
Assistant Executive Secretary of the Commission

THE EARLIER PAPERS IN THIS PANEL (see *Science*, April 9, pp. 355–363) have very wisely assessed adequacy of scientific personnel resources in terms of what demands are likely to be over a reasonably foreseeable future. I should like, however, to move to a totally different type of appraisal and offer some suggestions as to their adequacy in terms of what our demands *should* be. As a means of doing this, I shall present to you the conclusions of the President's Commission on Higher Education, as they are contained in Volumes I and II, both of which have just been published as part of a series of 6 volumes carrying the general title, *Higher education for American democracy.*

The Commission, appointed by President Truman on July 13, 1946, is made up of 28 distinguished citizens from education and lay groups alike. George F. Zook, president of the American Council on Education, is chairman of the group, and Francis J. Brown, also of ACE, is executive secretary. The Commission was charged by President Truman with the task of re-examining our system of higher education "in terms of its objectives, methods, and facilities; and in the light of the social role it has to play."

Five major areas of inquiry were selected: (1) Establishing the Goals, (2) Equalizing and Expanding Individual Opportunity, (3) Organizing Higher Education, (4) Staffing Higher Education, and (5) Financing Higher Education.

A sixth volume of resource data will contain many of the basic statistical materials from which the Commission has formulated its recommendations.

The basic relationship of the Report of the President's Commission to our present discussion lies in the Commission's strong stand in behalf of the "Education for All" thesis. The Commission has pitched its judgment of the dimensions of American higher education upon the consideration of providing opportunities for all who have the talent to profit from such experiences.

Let us see what this means in terms of numbers. Those who are experiencing the extraordinary crowding occasioned by the highest collegiate enrollment in history may be somewhat shocked to know that the Commission has advocated a doubling of this enrollment by 1960. It should be noted that the Commission is not offering this figure as a prophecy of how many students *will* be enrolled in 1960, but rather is going on record as believing that at least 4,600,000 of our young people *should* be enrolled at that time. This conclusion is based on a long and careful appraisal of the mental profile of our population.

The basic material for this appraisal was drawn from the results of the Army General Classification Test which was given to 10,000,000 men entering the military service. The scores made on this test, when equated with the American Council on Education's college entrance examination, indicated that nearly one-half of our population of college age (18–21) has the ability to complete at least two years of the traditional type of college education. The studies show, further, that nearly one-third of our young people have the ability to complete four years of college education, plus graduate and professional work.

These are startling figures when taken in their historic perspective. Never in our history have more than 16% of our young people between the ages of 18 and 21 been enrolled in colleges. The present enrollment of 2,300,000 is equivalent to more than 30% of the number of our young people between 18 and 21. We should remember, however, that this enrollment includes 1,200,000 veterans borrowed from an older age group, and actually the percentage of college students among youth of the usual college age is even less today than it was in 1941. In constricting the educational opportunities of our young people we are building a cumulative national deficit, and we cannot permit this condition to continue.

The Commission does not expect that its pronouncement on the number of young people who should attend college will be unanimously acceptable. The fact remains, however, that the greatest testing program in history has simply confirmed the generally accepted assumption that a high native intelligence is rather widely distributed among the American people. The Commission believes that failure to develop this intelligence to the utmost is not only a wastage of our most precious natural resource, but

One of a series of four papers presented in a Symposium on Insuring Adequate Scientific Personnel Resources, held December 30, 1947, during the Chicago Meeting of the AAAS.

also a denial of our basic concept of equality of opportunity.

There are some who say that such a massive program of higher education can lead only to a disgruntled intelligentsia ripe for extreme political movements of the right or of the left. This, of course, was true in Germany, but the premise has little basis here. In the first place, the humane tradition of our system of education sets it apart, in most respects, from the German pattern, and we must continually strengthen this tradition as one of our surest bulwarks of democracy. Secondly, our system of government requires a very widely informed and a socially and morally competent people. We cannot overproduce socially intelligent citizens.

Thomas Robert Malthus, the English economist, in 1798 put forth the doleful theory that the increase of population would outstrip the means of production and bring eventual starvation. Malthus has since been proven wrong, for even our present shortages are relatively unrelated to our total means of production.

In the Malthus tradition, there are those today who hold that any material increase of college-trained personnel will outstrip the number of jobs requiring such training. But what they fail to consider is the creative leaven which is a part of effective education. For the present let me simply advance the premise that more education will produce more jobs, services, arts, and crafts and, better still, should aid us in raising generally our moral and social perspective—and this moral and social perspective must be raised. In Volume I, the Commission declares:

> In a real sense the future of our civilization depends on the direction education takes, not just in the distant future, but in the days immediately ahead. The three objectives selected by the Commission as deserving topmost priority are . . . to bring to all the people of the Nation:
>
> Education for a fuller realization of democracy in every phase of living.
>
> Education directly and explicitly for international understanding and cooperation.
>
> Education for the application of creative imagination and trained intelligence to the solution of social problems and to the administration of public affairs.

What does this mean in terms of "Insuring the Adequacy of Scientific Personnel Resources"? Let me quote again from the first volume of the Commission:

> It is imperative that we find not only the will but the ways and means to reorder our lives and our institutions so as to make science and technology contribute to man's well-being rather than to his destruction. We need to experiment boldly in the whole area of human relations, seeking to modify existing institutions and to discover new workable patterns of association. We must bring our social skills quickly abreast of our skills in natural science.

The irony is that the very developments which have precipitated this critical situation seem likely to aggravate it. The spectacular achievements of natural science, especially during World War II, are certain to bring increased pressure for scientific advance. Already it is suggested that scientific pre-eminence will be the keystone of national security. But will it? Can we depend solely, or even primarily, on natural science for our national safety?

In the recent war the margin of our scientific and technical superiority over our enemies was dangerously narrow at times, and the scientists themselves are warning us at every opportunity that they can provide no defense against the new weapons. It is they who are proclaiming most vigorously that this defense can be found only in the realm of social and political organization on a world-wide scale. To quote Albert Einstein for one: "Being an ingenious people, Americans find it hard to believe there is no foreseeable defense against atomic bombs. But this is a basic fact. Scientists do not even know of any field which promises us any hope of adequate defense. . . . Our defense is in international law and order."

Arnold Toynbee has identified in the history of civilizations what he calls the rhythm of "Challenge and Response." This is an interesting designation for what we have known usually as the survival of the fittest. His massive appraisal is simply a reiteration of what happens when political and social sclerosis grips a once-virile commonwealth. Those civilizations which do not meet the challenge fail. Those which have met the challenge in the past have often done so through an empirical procedure, made possible by time and circumstance. But the chances for such success on a trial-and-error basis have diminished steadily with the increasing complexity of social events. Today, although our power for influencing social and physical forces is greater than at any time in our history, the problems which must be faced have grown proportionately in their complexity. But we are nearer than ever before to the point where we can *control* our history. It is a prospect so staggering in its immensity that for the moment it must be, as described in the less-well-known second verse of our National Anthem, "the shore dimly seen."

Let me point out that in emphasizing education for democracy the Commission in no sense desires to suggest limitations on progress and on experimentation in other directions. Neither does its stand for a vast expansion in enrollment carry the idea of unguided increases in all subject matter fields. The recommendations are very explicit on this point:

> In accepting its fundamental responsibility to help individuals prepare to make a living and to help society

get on with its work, higher education cannot rely on chance or on automatic processes to determine the number of persons it is to train in the various professions.

Educators must study carefully and continuously the professional requirements of society, so that the number of graduates in each field may approximate as closely as possible the estimated need for that kind of service.

Estimating the future needs in the various occupations and the number of persons to be trained to meet the needs is a complicated process in which many factors of varying weight must be taken into account and certain basic assumptions must be made. It is easy to go wrong in such attempts at forecast. Nonetheless, rational planning for the vocational programs of higher education must be based on the best expert estimates that can be made.

A thorough and continuing national survey of professional needs is necessary and should be developed promptly, but only after careful consideration and clear decision as how it is to be made and under whose auspices. Without such a decision, as awareness of the need for an occupational survey grows, many of them will be undertaken. And not only is this kind of duplication costly; it may well contribute to the danger of competition in the recruiting of professional personnel. Such competition is especially likely to occur in fields and periods of manpower shortage, although these are precisely the places and times when carefully planned use of manpower is most necessary to the Nation's welfare.

The Commission felt strongly that the major impetus for adjusting the number of professional personnel in terms of social needs should come from within the various professional groups. Its Report lashes at the tendency in some professions to restrict numbers arbitrarily in order to maintain prestige of the profession and the market value of its services. Natural factors, such as adequate facilities and high costs, are restrictive enough; deliberate limitation, regardless of social need, cannot be defended. If we could find a way of securing fair and equal distribution of the graduates of professional schools, we probably should discover that we are nearer starvation than saturation in many of the professions.

The Commission's stand on these matters is direct and constructive:

> What we need in this situation is social imagination. Instead of being afraid that we will overcrowd the professions, we should seek ways and means of expanding their horizons of social usefulness, of multiplying opportunities for professional service, of creating new professions and more employment opportunities in some of the old ones.
>
> Our society has not reached the limits of its development. In the whole area of medicine and public health there is need for a vastly expanded professional service. The growing field of communication will open up an array of new occupations on the technical and professional levels. So will developments to come in regional and community planning, in social service, in public administration, in clinical psychology and psychiatry, in personal and social counseling services of all sorts.

The new opportunities, occupations, and professions that may come with the development of atomic power and its application to industrial purposes cannot be foreseen. This development is likely to effect changes in our ways of living and working as far reaching as any that attended the historic industrial revolution.

> Higher education must be alert to anticipate new social and economic needs, and to keep its programs of professional training in step with the requirements of a changing and expanding cultural, social, and economic order.

Let me emphasize that in advocating the selective expansion of higher education the Commission is greatly concerned that there be no dilution in the quality of the work offered. There is an abiding overtone throughout the Commission's Report looking toward the constant improvement of the educational process. In the physical and natural sciences, the Commission has put forward proposals aimed at equipping the prospective scientist with a broad understanding of the social issues related to his subject-matter field. These proposals have been discussed briefly. It is time now to turn to the matter of the actual subject-matter education.

Volume IV of the Commission's Report, *Staffing higher education,* will deal in some detail with the actual procedures recommended for improving the student's mastery of research training techniques. Along this line, there are a number of unique proposals to which I commend your attention.

Many of you are doubtless convinced that a program of the magnitude suggested by the Commission is greatly to be desired. At the same time you are undoubtedly wondering how the students could be found to warrant a program of such size. It is perfectly true that no such expansion of enrollment is possible under existing circumstances. For every college student—good or bad—enrolled in 1941, there were at least two other young people, within the 18–21 age bracket, with above-average mental ability, yet unable to enroll. This condition has been prevalent for years and, under the pressure of higher tuition and living costs, is worsening steadily.

The Commission does not subscribe to the belief that higher education should be confined to an intellectual elite, much less an elite drawn from high-income families. Yet, in many of the professions, and even in the straight liberal arts course, this condition is becoming increasingly prevalent. The Temporary Commission to Study the Need for a State University in New York has compiled con-

vincing evidence to attest the wide distribution of intelligence among children in all income groups. There is tragic and overwhelming evidence, too, supporting the absolute lack of correlation between high mental ability and college attendance. The President's Commission sums up its position with these words:

> It is the responsibility of the community, at the local, State, and National levels, to guarantee that financial barriers do not prevent any able and otherwise qualified young person from receiving the opportunity for higher education. There must be developed in this country the widespread realization that money expended for education is the wisest and soundest of investments in the national interest. The democratic community cannot tolerate a society based upon education for the well-to-do alone. If college opportunities are restricted to those in the higher income brackets, the way is open to the creation and perpetuation of a class society which has no place in the American way of life.

The economic barrier is not alone as a major deterrent to higher educational opportunity. For thousands of our youth, regional, racial, religious, and similar issues unduly constrict access to higher education in many institutions. Against such obstacles the Commission is strongly committed:

> Discrimination in the admission of college students because of an individual's race, creed, color, sex, national origin, or ancestry is an antidemocratic practice which creates serious inequalities in the opportunity for higher education. The Commission is opposed to discrimination and believes it should be abandoned.

Further, the Commission believes that:

> Colleges have a unique opportunity to offer an experience in tolerance and understanding which grows out of democratic relations with students from various national and religious backgrounds. Colleges should become laboratories of inter-race and interfaith fellowship.
>
> This Commission urges educational institutions to act as pioneering agents of leadership against discrimination. Each institution should conscientiously plan and prosecute a well-organized program to reduce and, where possible, promptly to eliminate discrimination, not only by correcting its policies and practice, but also by educating its students to seek the abolition of discriminatory practices in all their manifestations.

Let me point out that the Commission is fully aware of the explosive social content of this problem. There is full recognition also that the changes advocated cannot occur overnight. I think the Commission's solution can best be described as "expedited evolution."

It is often said that colleges and universities reflect rather than shape public attitudes; that educational institutions cannot run counter to community sentiment, tradition, and alumni attitudes. To some extent, of course, this is true. But this factor cannot be made the excuse for inaction within the colleges.

When colleges admit all qualified students—when scholarship, ability, and other defensible standards are made the basis of admission rather than race, color, creed, sex, national origin or ancestry—then a democratic solution will have been reached. When our colleges and universities are being vigorously administered in ways which promote equal opportunity for all qualified students, the local communities and the community of the Nation cannot help but follow such leadership in other areas of our national life.

Discrimination and segregation affect a relatively small percentage of our youth of college age. Economic handicaps play a major role in constricting the higher educational opportunities of literally millions of our ablest young people. The Commission is operating on the premise that the most conscientious efforts of individual families and of the several states will be inadequate to care for a large proportion of these poor but talented youth. To this end, the Commission has evolved proposals for a national program of scholarships and fellowships which could eventually amount to nearly $1,000,000,000 a year.

The Commission is convinced that existing scholarship and fellowship funds are inadequate if higher education is to fulfill its responsibility to the individual, to the Nation, and to the world. Consequently, it is advocating that, beginning in 1948, there be established a National program of Federal scholarships in the form of grants-in-aid for at least 20% of all undergraduate, nonveteran students. The Commission is convinced that individual need, coupled with the requisite qualifications of total personal abilities and interests, should be the controlling factor in the selection of the recipients of such aid. The amount of this aid for the individual student might go as high as $800 per year. It is believed that such a program might provide aid for as many as 300,000 students at a total cost of $120,000,000 for the first year.

The Commission proposes that, as the number of nonveteran students rises, the amount of money available and the number of students aided should increase for the 5-year period between 1948 and 1953. At the end of that time, the program would be reexamined in order to determine if variations were needed.

The Commission is also anxious to provide appropriate and adequate encouragement of graduate study as a means of assuring the Nation of an adequate supply of highly trained personnel. To this end, it has been recommended that Federal funds be appropriated to provide for the establishment of a

national program of fellowships. The amount of each fellowship is set at $1,500 per year. Provision should be made for 10,000 such grants in 1948–49; 20,000 in 1949–50; and 30,000 in 1950–51 through 1952–53. Recipients should be selected on the basis of a national competitive examination. Each fellowship would continue for a maximum of three years if the student maintained acceptable academic standards of attainment, with explicit renewal each year to qualifying students. The holder of each fellowship would be allowed to select his own field of graduate study and to pursue it at an institution of his own choice, if the university selected offers appropriate courses in his chosen field.

The program here recommended would entail a Federal appropriation of $15,000,000 for the academic year 1948–49, $30,000,000 for 1949–50, and $45,000,000 for 1950–51 and the two succeeding years. This appropriation is in addition to that proposed for the Federal scholarship program and in addition to funds provided for other fellowships already made available in specialized fields.

The Commission recommends that, to carry out the scholarship and fellowship programs proposed, an appropriate and nationally representative Federal Board for Student Aid should be created. This board should be associated closely with the Federal agency primarily responsible for higher education.

Only as the opportunity for higher education is equalized for every potential student who has the interest and the ability to profit from college and university study at both undergraduate and graduate levels, can the ideals of democracy in education be realized. The program of scholarships and fellowships here proposed is not for the welfare of the individual alone, but is vital in the national interest.

This vast system of scholarships and fellowships should be supplemented by immediate action on the part of the colleges in reducing their fees. The Commission recommends that in publicly controlled institutions there be no tuition or fees in the 13th and 14th school years and that fees above the 14th grade be cut back to the level prevailing in 1939. This proposal is tied directly to one of the Commission's most important recommendations—*the nationwide establishment of community colleges to provide free instruction for the 13th and 14th school years.* This massive expansion of educational opportunity will go far toward increasing the reservoir of talent from which our top-flight scholars may be recruited.

How can we insure the adequacy of our scientific personnel resources? I hope that more and more we can focus our thinking on this issue in terms of what we want America's future to be. I believe that future can be as satisfying as we choose to make it. The events of the 20th Century have thrust upon us an unprecedented opportunity for choosing a future of security and abundance for all. That choice can be made and sustained only if we continue to improve the social and moral responsibility of all of our citizens. In the eyes of the Commission, subject-matter competence alone is no longer the mark of an educated man. The colleges are now obliged to produce an ever-increasing number of humane and socially alert citizens. Advances in nuclear research have given us a power potential which in 1947 is 40,000,000 times greater than that which was available through all of our power combined in 1939. We have certainly made no commensurate advance in our ability to give socially constructive direction to that power. The direction of this great power toward the achievement of a free and secure world is the challenge which the rhythm of history has brought to 20th-century America.

The fullest development of our human resources, based upon the broadest possible expansion of educational opportunities, answers that challenge. And the answer is given in a manner consonant with the highest aspirations of the American tradition of democracy.

Adjustments in University Plans and Programs to Meet Long-Range Needs

Arthur S. Adams, *Provost*
Cornell University, Ithaca, New York

A CRUCIAL PROBLEM WHICH FACES THE NATION today has been identified and documented with abundant and carefully sifted data by the preceding speakers. In addition, suggestions have been made as to how we might best plan to meet the situation. I have been asked to discuss what seem to me to be necessary adjustments in university plans and programs.

I believe we can agree at the outset that all personnel plans and charts of demand for specially trained individuals in various categories must be viewed only as our present best estimates of the situation and not as inflexible and precise blueprints of the future. From what has already been said, we see that differences of opinion exist concerning the immediate needs for scientific personnel in certain specialized areas, and that our task is complicated further by the fact that the immediate problem differs considerably from the long-term one. Commissioner Clague has indicated that while the current need for scientists and engineers is great, present-day enrollment in colleges and universities is such that in a few years graduates in some of the technical fields, notably engineering, may have difficulty in finding employment specifically related to their training. M. M. Boring, of the General Electric Company, in the October issue of the *Journal of Engineering Education,* also concludes that there is likely to be an oversupply of engineers about 1950, with certain engineering specialties having a much greater oversupply than others. Volume IV of the Steelman Report states the problem in a somewhat different way. It sets forth that while there will be too few scientists in the next two or three years to permit the large-scale expansion of research and development programs currently envisaged in our national policy, the immediate attempt to train additional scientists might do more harm than good, since in the long run "there is a danger of a shortage of *high-quality* scientists because of current overcrowded conditions in colleges and universities."

The above remarks are not alarming to me. In my experience there is nothing new in the fact that a man or woman trained along a particular line later finds employment opportunities restricted in that line and undertakes a job, often with great success, in another and related field. As we look over the past 20 years of history in our country, we recall the terrors of technological unemployment which faced us in the early '30s and then, only 8 years later, the scarcity of technically trained men to carry on our war effort. Of course, it would seem highly desirable from the standpoint of the utilization of manpower to have the number of jobs exactly match the number of people trained for them, but when I say that this might be highly desirable, I mean only from the theoretical standpoint of social planning. Actually, I consider it fortunate that changing conditions make precise planning in this area impossible, for I see grave limitations in an education so restricted in outlook as to provide an adequate basis only for one type of occupation.

It seems to me axiomatic that education, to be worthy of the name, must do much more than fit a person for a particular vocational slot in the social system. Our objective should be to determine and then develop, to the fullest possible extent, the capacities and aptitudes of individual students. Unless the individual has greater resources than those demanded by any specific job he may undertake, he lacks that adaptability to changing circumstances which is not merely the hallmark of the educated man but the margin of flexibility which permits our democratic society to progress.

It is a dangerous fact that even in the universities we sometimes, these days, forget the importance of the individual student. Overrun with numbers far greater than we had opportunity to plan for, we are apt to have our thinking conditioned by the necessity of facing physical problems of housing, of classroom space, of schedules, and always of budgets. If we are to meet the challenge of our scientific personnel needs, we in the universities must concern ourselves vigorously with the effective education of the individual. This will require more careful evaluation of his or her potential capacity. In short, we should give full attention to the identification of talent at the earliest possible stage of the individual's college career. Indeed, if such identification can be made and made

One of a series of four papers presented in a Symposium on Insuring Adequate Scientific Personnel Resources, held December 30, 1947, during the Chicago Meeting of the AAAS.

effectively in the secondary schools, it should be done there. I presume that it is too early to determine the results of the Science Talent Search supported by the Westinghouse Electric Corporation, but I am sure that this program is a really fundamental experiment in the early identification of scientific ability.

After identification has been made of the individual who shows promise of capacity as a scientist, what shall we do with him? Shall we require of him that he go through the conventional pattern of higher education, or shall we make a conscious effort to see that his potential talent is cultivated? I do not for a moment suggest that he be set apart from his fellows as a sort of intellectual curiosity, for if there is one thing that I am sure the scientist of the future needs, it is keen awareness of the social implications of his work. I do believe, however, that often a student of superior capacity is bored by the inadequate challenge to him of conventional academic requirements. Of course, many universities have recognized this, and various procedures for honors courses and for special laboratory work have been established. It seems to me, however, that much more could be done in this direction, and especially along the line to be suggested.

The counseling of college students is an activity that has expanded remarkably and successfully during the last two decades. It is my observation, however, that this counseling is usually concerned with problems of personal adjustment of the student to his environment. I now wish to suggest a program of professional counseling for the student who has been selected as one of promise in scientific work. There is nothing really new in this idea. The earliest educational procedure of which we have any record is study under a master. We find in a good deal of scientific literature that some great scientific figure of today was a pupil of, say, Rutherford or, in our own country, a pupil, for example, of Carlson. The effect of these masters on the whole trend of scientific thought and activity is incalculable. By reason of our preoccupation with numbers and dollars in American higher education today, we are apt to forget that the most potent force in the education of scientists is the opportunity to associate with a scientist who has achieved full professional stature.

To establish a practicable program of professional counseling will require the most careful sort of administrative planning, for the supply of those capable of undertaking such a role is distinctly limited; moreover, since such persons are leaders, they are sought out by government and by industry for great responsibilities as consultants. I submit, however, that the most valuable contribution that such leaders can make is that of multiplying their personalities by their guidance of groups of scientists in training.

We approach this ideal of education more closely in the graduate school, but here we are plagued with other limitations. The growth of knowledge in the natural sciences has been stupendous since the turn of the century, and I should judge qualitatively that the increase is certainly exponential. Yet, we are carrying on graduate study in accordance with much the same pattern that was in effect in the closing years of the 19th Century. It appears to me that universities must give immediate attention to a critical evaluation of stipulated course requirements for advanced degrees. They must put genuine emphasis on the statements that appear so generally in the announcements of graduate schools that the advanced degree is conferred not for attendance in courses but for evidence of productive scholarship. I believe that graduate study might be initiated earlier for those who demonstrate capacity for it. It also seems abundantly clear that graduate schools must make a reappraisal of formal residence requirements in order to make maximum use of the superior facilities for graduate study provided today by large-scale cooperative research installations such as the Brookhaven National Laboratory.

I venture further to suggest that all those who employ scientists should make provision for giving them a periodic opportunity for refresher postgraduate work. As is well known, certain agencies of the government and some industrial concerns already have initiated such programs. As a corollary to this proposition, graduate schools should set up such arrangements of staff and facilities as will give the greatest possible opportunity to the scientists engaged in postgraduate study.

Again, as Mr. Hausrath pointed out (see *Science*, April 9, p. 360), we need to provide opportunity for graduate students to become accustomed to working as teams. In undertaking the teaching of this procedure, scrupulous care must be exercised to insure that the individual's independence of thought is in no way curtailed. The experience of research scientists during the war shows that, while great objectives can be achieved by team research, there is a real danger that the researcher will become merely a technician. A difficult problem is presented by the resolution of the conflicting philosophical bases of free scientific inquiry by the individual and the necessity of fitting together the work of a number of individuals. To my mind, however, this is a problem that can and must be solved. In some ways it has all of the aspects of the conflict of interests that occurs in a democracy: The importance of the individual must never be forgotten, but his effort through his own

self-discipline must be coordinated with the effort of other individuals.

It is commonplace to say that graduate education is the most expensive type of education there is; moreover, graduate study is encumbered with a number of outmoded practices that make it difficult to determine the actual cost. In order to assist a graduate student in making ends meet, the university often awards him an assistantship with free tuition in the graduate school. If he is preparing for a career as a faculty member, the assistantship may give him a valuable opportunity for practical work in teaching. Unfortunately, however—and again, because of the pressure of numbers—the graduate assistant does not receive much guidance in carrying out his duties and so may come to look upon his assistantship work as a menial chore. This does not do him any good and it does even less good to the undergraduate students who are under his ministrations. It seems to me that in view of the national need for well-educated scientists, recognition should be given to the need of funds to support such a program properly. If graduate students plan on a teaching career, their practical work as assistants should form a part of their educational program and not be a distasteful job that has to be done in order to earn a little money.

I note that in the report of the President's Commission on Higher Education a recommendation is made that the Government give financial support to professional graduate study through a system of scholarships, fellowships, and direct grants to the colleges. I happen to be of the opinion that, while some governmental aid may undoubtedly prove most necessary and desirable to insure the solution of this problem, there are other and important steps that should be taken at least concurrently. The universities themselves, by making a thorough reappraisal and reorientation of the graduate program, can do much to make it more effective and to provide a fair proportion of the funds necessary. I believe, also, that industry, which certainly benefits from professional scientific study, should assist in meeting the cost. As is well known, a number of prominent industries already do this, and do it without imposing any restrictions whatsoever upon where the individual shall undertake employment. If, in the end, the measures undertaken by universities and industry should prove inadequate to meet the need, governmental support might be given through the media of scholarships and fellowships to those individuals who have fully demonstrated their ability and promise of further achievement.

In my opinion, however, it would not be good for science education or the Nation for the Government to undertake the whole financial support of insuring adequate scientific personnel resources. It has become too much the fashion to look to government for money to solve all problems. I believe that the surest and best solution lies in the strength of the individual student, professor, and university, with only such governmental participation as is needed as a last resort.

NEWS and Notes

Rufus Oldenburger, formerly professor of mathematics at Illinois Institute of Technology, has been appointed chairman of the Mathematics Department at De Paul University, Chicago.

Chester I. Barnard, president of the New Jersey Bell Telephone Company, will become head of the Rockefeller Foundation on July 1, succeeding **Raymond B. Fosdick,** who plans to retire. Mr. Barnard was national president of the USO during the recent war and is a consultant to the American representative on the UN Atomic Energy Committee.

Frederick K. Sparrow, Jr., associate professor of botany, University of Michigan, will take sabbatical leave covering the second semester of the 1948–49 year in order to participate in a study of aquatic plants in relation to mosquito populations in the region of Villaviciencio, Colombia, at the laboratories of the Rockefeller Foundation.

Carl Eckart, formerly director of the University of California's Marine Physical Laboratory in San Diego, on March 1 became director of the Scripps Institution of Oceanography, succeeding **H. U. Sverdrup,** who has held the post for the past 12 years.

E. V. Staker, associate professor of agronomy in the chemurgy project, University of Nebraska, Lincoln, joined the staff of Gen. MacArthur's Far East Command in Tokyo in mid-March. Dr. Staker will have the responsibility of determining fertilizer needs and assisting with importation and distribution of fertilizers and general supervision of the soil and crop program in Japan, southern Korea, and Okinawa. His assignment is for a minimum period of two years.

Bruce A. Rogers, who has been associated with the U. S. Bureau of Mines since 1935, has been appointed senior metallurgist in the Atomic Research Institute at Iowa State College.

Karl Ver Steeg, of the Department of Geology and Geography, College of Wooster, Wooster, Ohio, will mark his 25th year of service to the College this spring. In honor of this occasion a group of his former students, under the chairmanship of Shannon McCune, of Colgate University, are organizing a special program for May 7–9 at Wooster. There will be two formal sessions along the lines of Dr. Ver

Steeg's professional interests. One, to be directed by Paul Shafer, of the University of Illinois, will be concerned with the place and content of geology and geography in the liberal arts college. The second, arranged by H. T. U. Smith, of the University of Kansas, will consist of research papers contributed by some of Dr. Ver Steeg's former students. At a dinner on May 7 in honor of Dr. and Mrs. Ver Steeg letters from students scattered over the world and messages from colleagues, friends, and scientific societies will be read.

Zola M. Fineman, formerly with Alaska Agricultural Experiment Stations, Palmer, has been appointed associate horticulturist anl superintendent of the University of Arizona Vegetable Research Farm at Tempe.

Philip C. Huntly, head of the Department of Civil Engineering at Illinois Institute of Technology, has announced that he will retire at the end of August. Prof. Huntly has been department head since 1938 and an engineering consultant for the Armour Research Foundation since its establishment.

L. Frederic Hough, formerly assistant chief in horticulture, University of Illinois, was appointed professor and research specialist in horticulture at the New Jersey Agricultural Experiment Station on March 1. Prof. Hough will continue the breeding program with tree fruits and small fruits which the Department of Horticulture has been conducting for over 30 years.

Francis Cope Evans, at present assistant professor of biology at Haverford College, has been appointed assistant biologist in the Laboratory of Vertebrate Biology and assistant professor of zoology at the University of Michigan beginning on July 1.

Awards

The $5,000 cash award made annually by the Passano Foundation goes this year to Helen B. Taussig, associate professor of pediatrics, and Alfred Blalock, professor of surgery, Johns Hopkins Medical School, who developed the successful operative procedure popularly known as the "blue baby operation." The award will be presented at the Palmer House in Chicago on the evening of June 23, during the convention of the American Medical Association. Since the first such operation was performed late in 1944, more than 600 patients from all over the world have been operated on at Johns Hopkins alone.

The Passano Foundation, established by the Williams & Wilkins Company, Medical Publishers, Baltimore, Maryland, to aid the advancement of medical research, especially that which bears promise of clinical application, has made three previous awards. These have gone to E. J. Cohn, Harvard University, for his work on fractionation of blood; Ernest Goodpasture, Vanderbilt University, for virus culture by the chick embryo method; and Selman Waksman, of Rutgers University, for the discovery of streptomycin.

Marvin J. Udy, consultant in chemistry and metallurgy of Niagara Falls, New York, has been awarded the 1948 Jacob F. Schoellkopf Medal of the Western New York Section of the ACS for his contributions to the refining and utilization of chromium.

H. K. Hartline, associate professor of biophysics at the Johnson Foundation, University of Pennsylvania Medical School, was recently awarded the Howard Crosby Warren Medal by the Society of Experimental Psychologists. The award was made at the 44th annual meeting of the Society, held at Bryn Mawr College on March 26. Dr. Hartline received the medal "for his study of the processes of light and dark adaptation in single photoreceptor elements." The citation continued: "In this investigation Hartline applied the method of recording impulses from single photoreceptor units, a technique which he has raised to new levels of effectiveness. Hartline's application of a delicate and precise technique has provided us with information which will be invaluable for specifying certain limiting parameters of a theory of visual discrimination."

The Harold Albert Wilson Research Award in Physics has been established at the Rice Institute, Houston, Texas, by holders of advanced degrees in physics from that institution. Dr. Wilson became professor of physics at Rice in 1912 and retired in September 1947 as professor emeritus. A committee composed of Norman Ricker, of the Research Department, Carter Oil Company, Tulsa (chairman), Maurice Ewing, associate professor of geology at Columbia University, and T. W. Bonner, professor of physics at Rice, has been appointed to carry out the plans of the group. The award will be conferred annually on a Rice graduate student in physics for a piece of outstanding research done in the course of his study for an advanced degree.

Wortley F. Rudd, dean emeritus of the School of Pharmacy in the Medical College of Virginia, has been awarded the 1948 Herty Medal for outstanding contributions to chemistry in the Southeast. The Herty Medal is given annually by the Chemistry Department of the Georgia State College for Women to a scientist selected by the Georgia Section of the ACS. Dean Rudd, who retired last year after 41 years on the faculty of the Medical College of Virginia, is a former president of the Virginia Academy of Science, the American Association of Colleges of Pharmacy, and the Southern Association of Science and Industry, of which he was a founder.

Fellowships

A graduate Teaching Fellowship in Bacteriology is available for a woman at Smith College for the year 1948–49. The fellowship is renewable for a second year ($800 for the first year and $900 for the second year, plus tuition and fees). Under this type of fellowship a requirement of part-time assistance in laboratory work permits completion of work for the A.M. degree in two years. Inquiries should be addressed to: Chairman, Department of Bacteriology, Burton Hall, Smith College, Northampton, Massachusetts.

The Fanny Bullock Workman Travelling Fellowship, given to an outstanding graduate student at Bryn Mawr College, has been awarded for the coming year to Esther Duke Redding, a graduate student in physics. Mrs. Redding, who will use the fellow-

ship to spend a year at the University of California, Berkeley, took her undergraduate degree in chemistry at Wellesley College and spent several years with the National Institute of Health before entering the Graduate School at Bryn Mawr.

Colleges and Universities

The University of North Carolina has recently established an Institute of Fisheries Research with headquarters at Chapel Hill and a research laboratory at Morehead City. The director of the Institute is Robert E. Coker, Kenan professor of zoology at the University. Harden F. Taylor, of New York, has been designated as associate director. Members of the staff who have entered upon duty or will soon do so are W. A. Ellison, Jr., fisheries specialist, formerly staff production technologist with the Atlantic Coast Fisheries Company; A. F. Chestnut, specialist in oyster culture, recently director of the New Jersey Oyster Research Laboratory; E. W. Roelofs, specialist in hydrobiology, formerly with the Michigan Fisheries Research Laboratory and recently in charge of research on stream sanitation and textile waste disposal problems with the Institute of Textile Technology; and Carter Broad, scientific assistant, recently a graduate student in the University's Department of Zoology. Hilary B. Moore, of the Woods Hole Oceanographic Institution, is serving on a part-time basis as biologist on the Shrimp Survey.

A survey of shrimping grounds off the North Carolina coast is now in progress. For this work the Navy schooner *Reliance* is being employed with the cooperation of the Naval Hydrographic Office, and the Woods Hole Oceanographic Institution is furnishing two oceanographers and a geologist. The most modern equipment is being used to map the bottom and to study the general oceanographic and biological conditions. Shrimp trawls and try nets will be used in an effort to locate possible additional supplies of shrimp and commercial fishes. The staff hopes to learn more about the biology of the shrimp and to gain information that will be helpful not only to the shrimp fishery but also to other commercial fisheries.

In addition, studies and experiments concerning the oyster are being inaugurated which may serve to guide state planting and promote private oyster farming. Special studies will be made of the biological and physical conditions in the extensive sounds inward from the North Carolina Banks and of the relations of such conditions to the distribution and movements of oyster and clam larvae, shrimp, crab, and fin fishes. It is planned also to deal with the technology and economics of fishery industries in order to promote the most profitable utilization of North Carolina's extensive fishery resources.

The University already offers courses in hydrobiology with some introduction to oceanography. Expansion of the training program is contemplated.

Establishment of a Toxicology Division and Toxicology Laboratory in the Medical School of the University of Buffalo has just been announced. The new unit, supported jointly by the University and the County of Erie, will work closely with city and county authorities, with hospitals, and with industry in the determination of poisons. Niels C. Klendshoj, associate in pathology, who has been working under Kornel Terplan, head of the Medical School's Department of Pathology, is director of the Division, and Milton Feldstein, who has had considerable experience in this field at Bellevue Hospital, New York, and in the Army Sanitary Corps, will perform the experiments.

The 5th annual D. J. Davis Lecture on Medical History will be given this year at the University of Illinois College of Medicine, 1853 West Polk Street, Chicago, by John F. Fulton, Sterling professor of physiology at Yale University's School of Medicine. Dr. Fulton's talk, on "The Position of William Withering in the History of Scientific Medicine," will be given at 1:00 P.M., April 28. This lectureship was established by associates and friends of Dr. Davis upon his retirement as dean of Illinois' College of Medicine in 1943.

The 7th Edwin R. Kretschmer Memorial Lecture of the Institute of Medicine of Chicago will be delivered on Friday evening, April 23, at the Palmer House by Julius White, head chemist, U. S. Public Health Service, National Institute of Health, Bethesda, Maryland. Dr. White's subject will be "Experimental Studies on Leucemia in Mice."

Meetings

The Wisconsin Academy of Sciences, Arts and Letters will hold its 78th annual meeting at Central State Teachers College, Stevens Point, Wisconsin, on April 23–24.

The 80th annual meeting of the Kansas Academy of Science will take place at Pittsburg, Kansas, April 29–30 and May 1. A special symposium on Friday will be concerned with scientific discoveries which have implications of social change. There will be a field trip on Saturday, May 1.

The present officers of the Academy are John C. Peterson, president; F. W. Albertson, president elect; Paul G. Murphy, vice-president; Frank C. Gates, secretary; D. J. Ameel, co-secretary; and Standlee Dalton, treasurer.

Jacques Bronfenbrenner, professor of bacteriology and immunology, Washington University School of Medicine, St. Louis, will deliver the I. M. Lewis Lecture at the meeting of the Texas Branch of the Society of American Bacteriologists to be held at the Baylor Medical School in Houston, Texas, April 30–May 1. His topic will be "The Relation of Reagins to Antibodies in the Light of the Unitarian Hypothesis." He will be the first speaker under this lectureship, recently established in memory of the late I. M. Lewis, for many years professor of bacteriology at the University of Texas, Austin, and one of the founders of the Texas Branch.

The American Institute of Chemists will commemorate its silver anniversary at a meeting on May 7 at the Waldorf-Astoria in New York City. The afternoon program will feature an address by Foster D. Snell, retiring president, after which "The Professional Activities of Other Societies" will be discussed by a panel of speakers including Charles C. Wilson, assistant to the secretary, who will talk

on the AIEE; W. A. Mosher, head of the Department of Chemistry, University of Delaware, who will outline the work of the ACS; E. L. Chandler, assistant secretary, who will review the program of the ASCE; and W. T. Nichols, of Westvaco Chlorine Products Corporation, who will cover the activities of the AICE. The annual business meeting will also be held and new officers elected. In the evening there will be a joint meeting and dinner with the New York Section of the ACS, at which the Institute's gold medal will be presented to Charles Allen Thomas, executive vice-president and technical director of Monsanto Chemical Company. Francis J. Curtis, vice-president of Monsanto, will address the group on "The Career of the Medalist."

The Third Symposium on Combustion and Flame and Explosion Phenomena will be held at the University of Wisconsin September 7–11. Formal papers will be presented on fundamental, experimental and theoretical aspects of various phases of the subject, including, among others, mechanism and kinetics of reations of explosive mixtures, dynamics of flame, detonation, spectroscopic studies on flames, and measurement of temperature and pressure in combustion gases. There will also be contributions on applied subjects. In addition, round-table discussions will be held on thermodynamics and the physical properties of hot gases, thermochemistry, hydrodynamics of reacting systems, turbulence and its effect on combustion, applications of spectroscopy to flame research, chemical kinetics, and instrument development and experimental techniques for combustion studies. Those interest in attending may obtain announcements of the symposium from Joseph O. Hirschfelder, Department of Chemistry, University of Wisconsin, Madison. According to Dr. Hirschfelder, a large number of foreign scientists have accepted invitations to attend.

A Symposium on Electron and Light Microscopy, sponsored by Armour Research Foundation of Illinois Institute of Technology and the Institute's Physics Department, will be held on the campus at Technology Center, June 10–12. The three-day session will consist of invited papers and planned discussion covering instrumentation, techniques, and applications of both electron and light microscopy. The supplementary relationship between the two fields will be emphasized. A number of leading microscopists have already informally indicated their willingness to present papers and to take part in the discussions, and it is expected that the final program will include about 15 speakers. Ample opportunity will be afforded for interchange of ideas and problems either in large discussion groups and panel meetings or by personal contact. In addition to the sessions being planned there will be an exhibition of electron and light micrographs, an equipment exhibit, and school and plant visits.

The complete program will be announced later. In the meantime further details may be obtained from either of the co-chairmen, W. C. McCrone or C. F. Tufts, of Armour Research Foundation, 35 West 33rd Street, Chicago 16, Illinois.

In view of the increasing use of hyaluronidase both in the laboratory and in clinics, a preliminary meeting was held in New York on March 8 for the purpose of reaching agreement as to ways of standardizing the enzyme. Present at this meeting were F. Duran-Reynals, Yale University School of Medicine; R. Kurzrok, 1016 Fifth Avenue, New York; R. McCullagh, Schering Corporation; C. V. Seastone, University of Wisconsin Medical School; and J. Seifter, Wyeth Institute of Applied Biochemistry.

The Committee on Medical Science of the Research and Development Board (National Military Establishment), which has been recently formed, is to have as its chairman Francis G. Blake, Sterling professor of medicine, Yale University, according to an announcement just made by Vannevar Bush, chairman of RDB. The Committee will be concerned with the survey, analysis, and evaluation of all aspects of research and development activities in the field of medical and allied sciences, within the Military Establishment. In its research and development activities the Committee will work closely with the Hawley Committee, appointed by the Secretary of Defense to review all activity in the Military Establishment related to medicine and allied sciences.

A variety of C^{14} compounds will be available to meet the increasing demand for such materials when a plan recently announced by the AEC is fully developed. The Commission's Isotopes Division has invited a number of commercial firms to consider the desirability of engaging in the synthesis and sale of such substances, and several firms have indicated their interest in doing so. Such a procedure would make compounds labeled with C^{14} more readily obtainable and at a lower cost than would be possible if the compounds were synthesized in small individual lots by investigators in their own laboratories. To date, Tracerlab, Inc., 55 Oliver Street, Boston 10, Massachusetts, is the only firm which has formulated its synthesis program. This company is now ready to receive orders for the following compounds:

Barium carbide—70%—not to be stocked; available one week after order is received.

Acetylene—$HC^* \equiv C^*H$—not to be stocked; can deliver one week after order is received.

Sodium cyanide—dry solid containing small excess of alkali; now available.

Methyl alcohol and methyl iodide; available May 1.

Carboxyl-labeled acetic acid, acetyl chloride, ethyl acetate; available May 1.

Benzene—low activity, *ca* 1 mc/100 mM; available May 1.

Methylene-labeled ethyl alcohol and ethyl iodide; available July 1.

Methyl-labeled acetic acid, acetyl chloride, ethyl acetate; available August 1–September 1.

Methyl-labeled ethyl alcohol and ethyl iodide; available August 1–September 1.

Except in the case of benzene, the specific activity will be of the order of 1 mc/mM of compound.

While commercial firms are develop-

ing their synthesis programs the commercially available compounds will be supplemented by others prepared in AEC laboratories.

The Commission has outlined the procedure for obtaining compounds containing C^{14} from commercial firms as follows:

(a) Communicate with the company to determine the availability and price of the compound desired.

(b) Send to the Isotopes Division an "Application for Radioisotope Procurement," AEC Form 313, requesting C^{14} in the form of the compound desired and mentioning the name of the firm from which purchase is to be made. After review and approval of the application, the Isotopes Division will return two copies of "Authorization for Radioisotope Procurement," AEC Form 374.

(c) Place a purchase order for the allocated C^{14} compound with the commercial firm. The original copy of Form 374 must be attached to the purchase order.

On April 1 the Commission also announced that certain radioisotopes useful in *therapy, diagnosis,* and *research in cancer* will now be distributed in this country without charge, except for handling ($10 per shipment) and transportation. These isotopes, with their catalogue numbers, are: Iodine 131 (S–2), Phosphorus 32 (S–3), and Sodium 24 (73). They may be obtained by submitting AEC Form 313 to the Isotopes Division.

A British National Committee for Crystallography has recently been formed by the Royal Society with Sir Lawrence Bragg as chairman. Representing the Royal Society on the Committee are W. T. Astbury, J. D. Bernal, Mrs. D. C. Hodgkin, Mrs. K. Lonsdale, Sir George Thomson, and C. E. Tilley. Representatives of other organizations include G. M. Bennett (Chemical Society), D. A. Oliver (Institute of Metals), E. G. Cox (Institute of Physics), C. Sykes (Iron and Steel Institute), F. A. Bannister (Mineralogical Society), and H. Wilman (Physical Society). P. P. Ewald, R. C. Evans, and W. H. Taylor, as members of the Provisional Executive Committee of the International Union of Crystallography, are ex-officio members of the National Committee.

The first meeting of the Committee was held February 11, when preparations were begun for the first General Assembly of the International Union at Harvard University, July 28–August 30.

The Navy Department is currently expanding three comparatively new, permanent laboratories in California. One of these, the Naval Ordnance Test Station, China Lake (formerly Inyokern), 160 miles from Los Angeles, originally an activity of CalTech, is presently engaged in research, development, and test work with ordnance equipment and explosives. Another of these is the Navy Electronics Laboratory, San Diego, which is an outgrowth of work done by the University of California. Here the work concerns research, development, and testing of electronic control devices, detection and instrumentation equipment, and training aids. The third is the Navy Air Missile Test Center, situated at Point Mugu, 60 miles north of Los Angeles. The Center's work consists of flight and laboratory testing and evaluation of guided missiles and their components.

Each of these establishments needs qualified personnel in a variety of scientific fields, and it has been announced that examinations are now open for professional positions as chemist, mathematician, metallurgist, meteorologist, physicist, statistician, scientific research administrator, and scientific staff assistant. Examinations are also open in various branches of the engineering profession. Salaries for most of the positions range from $3,397 to $9,975 per annum.

According to the Navy Department Joint Board of U. S. Civil Service Examiners, 1030 East Green Street, Pasadena 1, California, from which further information may be obtained, the work programs of these laboratories are planned and directed by an outstanding staff of civilian scientists, and liaison is maintained wth other research organizations, universities, and scientific associations.

U. S. entomologists will undoubtedly be interested to hear that Fritz Priefert, well-known German entomologist, has offered to send free of charge to individual entomologists, institutions, or societies who have possibly aided him during past years insects which he collects and prepares. Because he and his wife are now living in one small room, he does not wish to begin extensive collections for himself. His own entomological collections, consisting of some 40,000 specimens, were lost. Knowledge of Mr. Priefert's offer has come to us through E. O. Essig, chairman of the Division of Entomology and Parasitology, University of California Agricultural Experiment Station. In transmitting this information Dr. Essig states: "This is an unusually generous offer, and I am sure that many systematic entomologists in this country might be interested in accepting it . . . possibly Mr. Priefert is in need of things that would enable him to get some satisfaction in later years out of doing some more work in entomology. Since he has lost his collection, perhaps he would like to have some pamphlets and books, if not actually the necessities of life." The Prieferts are now living at 24 Stade, Kehdingermühren 6, Germany.

Make Plans for—

American Physical Society, 285th meeting. April 29–May 1, Washington, D. C.

Nebraska Academy of Sciences, 58th annual meeting. April 30–May 1, University of Nebraska, Lincoln.

New York State Geological Association, annual field conference, April 30–May 1, Hamilton College, Clinton, New York.

West Virginia Academy of Science, April 30–May 1, West Virginia School of Technology, Montgomery, West Virginia.

American Society for Clinical Investigation, May 3, Chalfonte-Haddon Hall, Atlantic City, New Jersey.

★

AAAS

Centennial Celebration

Washington, D. C.

September 13–17, 1948

★

Comments and Communications

Distribution of Funds for Medical Research

In a recent leading article (*Science*, February 6, pp. 127–130) Clarence A. Mills, of the University of Cincinnati, severely criticizes the present manner of distribution of funds for medical research, thus bringing into the open a matter which has been the subject of a vigorous whispering campaign for a year or more.

The basis of Dr. Mills' criticism is that although the northeastern group of states, including Maryland and the District of Columbia, contain slightly less than 30% of the population of the United States, universities and other institutions in that area receive approximately 40% of Federal funds allocated for medical research and considerably more than 40% of funds allocated by privately endowed foundations and those supported by voluntary contributions from the public.

Moreover, a relatively few large privately endowed universities, notably Harvard, Yale, Columbia, and Johns Hopkins, now receive, in the opinion of Dr. Mills and those who share his point of view, a disproportionately large share of these funds; the serious charge is made that large funds are received because the memberships of consulting committees which recommend the grants are heavily weighted with faculty members of these same universities.

Phrases in Dr. Mills' article, such as "long-term dominance exerted over medical research by the older institutions of the eastern seaboard," "disturbing inequalities in the granting of such funds," "pernicious in end-results," tend to obscure two basic considerations: (1) that disbursing bodies would seem to be under obligation to place medical research funds where they believe the most productive research will ensue; (2) that the results of research benefit not primarily the institution or the locality in which it is carried on, but the country as a whole.

Men make discoveries, not institutions; in general, the more gifted the individual, the more will be his contribution to society. It has been my privilege to serve at various times on committees responsible for recommending research grants. These committees work hard, for it is not easy to spend research funds wisely. Invariably, discussion centers around the qualifications of the individual who is to be the responsible investigator, with little or no consideration being given to the university in which that person happens to be working.

Important among secondary factors favorable to productive research are believed to be the amount of time free of teaching or private practice available to the responsible investigator and his principal assistants, adequate laboratory space, basic equipment, and various ancillary services. It so happens that these favorable factors are found more abundantly in some medical schools than in others. Moreover, several universities include not one large group devoted to teaching and research, but two—a school of medicine and a school of public health, each with largely a full-time faculty, independent study body, and separate physical facilities. On the other hand, in many medical schools faculty members are heavily loaded with teaching and private practice, leaving little time for research.

In Volume 5 of *Science and public policy*, the report of the President's Scientific Research Board, the desirability of encouraging the development of medical research in the smaller and less well-known institutions is recognized. The National Advisory Health Council and the consulting committees of the National Institute of Health responsible for the allocation annually of approximately $7,000,000 of Federal funds for research in medicine and related sciences are keenly aware of this problem and are consciously making grants designed to support new groups in this field. But it is asking too much for research funds to bolster the whole structure of medical education throughout the country. Until medical schools are in a position to support a substantial portion of their faculty on a full-time basis, with sufficient free time for research, merely making grants to those institutions for specific research projects will not solve this important problem. The responsibility of the Federal Government with respect to medical education is another matter, which is beyond the scope of this letter.

At the present time therefore, allocation of Federal research funds on a strictly population basis, even within states, as Dr. Mills recommends, would lead to waste of public money and to shortchanging the people as a whole, who stand to benefit from medical research.

Research should be widely encouraged and supported wherever the opportunities seem promising. But to grant funds far beyond the capacity of an institution to use them to advantage is of questionable value, while to withhold funds from institutions where men and facilities are available appears to be contrary to the best interests of the country.

THOMAS B. TURNER

The Johns Hopkins University

Growth of Stumps

A view is presented here on the problem of stump growth. It is suggested that fluctuating temperatures during the winter and early spring initiate the cambial stimulus in the buds and everywhere in the bole, and that the downward course of its passage is governed by increasing diameter of the axis. This suggestion holds for stumps as well as standing trees. From the aspect of this thesis, the cambial stimulus is considered as enzyme activation and the change of stored foods to soluble products.

Stumps differ in behavior. Those of hemlock (W. J. O'Neil. *J. Forestry*, 1928, 26, 244–245), larch, and white fir increase in diameter, but those of spruce and most pines do not (J. H. Priestley. *New Phytol.*, 1930, 29, 316–

351). A few stumps of eastern white pine have been observed to callus over and increase in diameter (George S. Perry. Personal correspondence, 1939). Hemlock stumps will increase in diameter due to root graft unions with standing trees (O'Neil, *op. cit.*). A report cited by Priestley (*op. cit.*) states that a larch stump in a beech forest grew in diameter though no other larches were present. Stumps of many dicotyledons but few conifers produce shoots, and these appear at different levels on the stump. Most of the shoots from a stump are considered to have traces that extend to the pith. This view seems untenable to me, however, since (*Science*, October 4, 1946, p. 329) many shoots arise below the root collar, and error is possible with regard to the first few annual rings. Many factors of the environment are able to induce the formation of adventitious buds.

The reasons for the differences in behavior between stumps are obscure. Such factors as water supply, temperature, food reserves, responses to wounding, and the activation of buds of standing trees have been studied. Similar work is necessary with respect to activities in stumps.

A number of facts are known. Some of the stumps that increase in diameter have root graft unions with standing trees. Buds remain viable in stumps for varying periods of time. Diameter growth of the stump and the emergence of shoots from it indicate that the conditions favorable for meristem maintenance (and probably initiation as well) are present. It is obvious, therefore, that enough food and moisture are available and that a stimulus to bud and cambial activity appears.

The cambial stimulus is a process, not yet understood, that results in the initiation of cambial activity. In a standing tree the impulse to renewed cambial activity begins in the swelling foliar initials and then proceeds in a downward course to and into the roots, where such activity is sluggish and perhaps continuous (J. H. Priestley and Lorna I. Scott. *An introduction to botany.* New York: Longmans, Green, 1938; J. H. Priestley. *New Phytol.*, 1930, 29, 316–351). It probably does not enter the stumps across the root graft unions because the normal course in the tree is downward. Nutrient solutes available in the spring may be the cambial stimulus (Priestley and Scott's *An introduction to botany*; J. H. Priestley. *Forestry*, 1935, 9, 84–95). Contrary to the belief of many investigators that hormone action is the stimulus, it is suggested (*Forestry*, 1935, 9, 84–95) that solutes released in sieve tube differentiation during the spring are the cambial stimulus. There is also a suggestion (O. F. Curtis. *The translocation of solutes in plants.* New York: McGraw-Hill, 1935) that food solute movement and an electrical gradient are parts of the complex. It seems to me that there might be a condition that is something like after-ripening of seeds, with fluctuating temperatures, simulating seed stratification, entering into the situation.

Such fluctuation may lead to enzyme activity and make food reserves soluble in the swelling foliar initials, differentiating dividing tissue beneath quiescent growing points, and (in secondary tissue) in the phloem parenchyma and xylem ray parenchyma. This situation appears first in the buds because the diameter there is small. The process would follow a downward course through the shoots and the bole in the direction of increasing diameter. Such changes would lead to sieve tube differentiation in the phloem parenchyma, followed by cell division in the growing points and cambium, and the production and differentiation of primary tissue beneath the shoot apices. Solutes from the parenchyma elements, and finally from differentiating vascular elements, would lead to the nourishment of buds and an increasing expanse of cambium until all the elements in all the meristems are engaged in cell division. This basipetal progression of solute availability, begun by fluctuating temperature and governed by diameter, is the cambial stimulus.

Given a stimulus that begins and behaves in this manner, such an appearance should be equally possible in both standing trees and stumps. Only moisture, stored foods, and fluctuating temperature would be needed. A multiple of buds would not be necessary. The speed of the stimulus in ring-porous trees would seem to be too great for a downward movement of hormones. It is, more likely, a downward development of transverse availability of solutes, perhaps influenced by delaying action effects of bark of increasing thickness in a proximal direction. The effect of disbudding in delaying the downward spread of cambial activity would in consequence have to be within the realm of some other condition than hormone action—and what that is I do not know. Perhaps it may be interference with hydrostatic units that have to begin somewhere in a meristem terminal. The fact remains that stumps are known to increase in diameter. It is also certainly reasonable to believe that solute formation that is incidental to temperature would take place in regions of small diameter sooner, but would nourish cambium equally well anywhere.

ISADOR AARON

P. J. Oesterling & Son, Inc.

Courses on the Biochemistry of Cancer

In a recent announcement of a course on the Biochemistry of Cancer to be given this summer at the University of California (*Science*, February 6, p. 137) it was stated that it would be the first of its kind offered in a U. S. university. J. Murray Luck, professor of biochemistry at Stanford University, in a Letter to the Editor, comments that "... Stanford University already offers a course of lectures on the 'Biochemistry of Cancer.' Dr. Clark Griffin is the instructor, the present enrollment is 40, at has been in progress since January 7, and will be repeated annually." H. P. Rusch, director of the McArdle Memorial Laboratory for Cancer Research, University of Wisconsin, writes: "A course in Experimental Oncology emphasizing biochemical aspects is now a part of the official curriculum. . . . It is being given during the present semester by the faculty of the McArdle Memorial Laboratory for Cancer Research. Twenty-one graduate students are enrolled."

TECHNICAL PAPERS

The Laboratory Growing of Quartz

DANFORTH R. HALE

The Brush Development Company, Cleveland, Ohio

Synthetic or laboratory-grown quartz has been known in the form of microscopic crystals for over 100 years,[1] and 40 years ago several macro crystals were grown from seed, the largest increase having been about 3.1 gm. This was the achievement of Giorgio Spezia, mineralogist at the University of Turin, Italy, who used the hydrothermal method—sealing up quartz and dilute sodium silicate solution for 6 months at elevated temperature and pressure (*8*). His experiments demonstrated to the geological world that silica responded to its own crystallizing tendency many orders of magnitude faster at 150 atm and 320° C than at 6,000 atm and about 25° C.

Beginning in late 1943, Richard Nacken, in Germany, directed an attack on the problem of producing crystalline quartz in quantity, the use of quartz oscillator plates having become of enormous importance in military radio communication. He met with sufficient success so that a pilot plant seems to have been in operation at the end of the war, but to judge from information available through the Office of Technical Services, the work did not yield a formula for a commercial process (*11*).

TABLE 1

	Total quartz deposited (gm)	Growth rate (mg/cm²/day)	Length of run (days)
Giorgio Spezia	3.1	38	200
Brush Development Co.	6.9	48	20

At a Symposium on the Synthesis of Single Crystals held during the Boston Meeting of the AAAS (December, 1946) it was announced that a number of projects for crystal growing were being sponsored by the U. S. Signal Corps in the interest of an improved position with respect to frequency control. Under this program the Brush Development Company has a contract to investigate the growing of quartz.

A method currently being explored by the Company consists of heating at the bottom a vertical tubular autoclave containing a dilute alkaline solution, a quantity of silica at the bottom to act as supply or feeder material, and one or more "seeds" cut from untwinned quartz crystals suspended near the top. The autoclave is made of chemically resistant steel capable of safely withstanding high internal pressure. Comparison of a fairly successful run with the estimated best results obtained by Spezia shows that progress toward higher rates of growth has been made (Table 1).

The supply in both experiments was crystalline quartz. Spezia's seed was cut normal to the optic axis, and the seed in the comparison experiment was cut parallel to a major rhombohedral face, a surface which normally grows at a much lower rate.

The number of millimeters of oriented quartz deposited on each face per day provides a comparison of growth rates if the seeds have the same area and are of the same "cut." Growth on different cuts or faces occurs at different rates. The rates on the R-cut, parallel to the major rhombohedral face, and the Z-cut, or artificial basal face (not existent in nature), are in the ratio of about 1 to 5. This is in accord with the "overlapping principle" that the largest natural face of a crystal is the one that grows most slowly (e.g. *5*). Growth on the Z-cut is usually so rapid that a porous structure results, except at the edges where the oblique rhombohedral faces begin to appear. These faces tend to grow as continuous planes, repairing and covering the open spaces beneath and making inclusions of them, after which the growth is normally unflawed.

This growth sequence on Z-cuts seems standard, and similar behavior has been observed in the growth of large crystals from water-soluble substances. In several experiments, however, a slow but dense growth of quartz in the Z-direction occurred. The pyramid was incomplete, due to insufficient time, with perhaps other conditions contributing, and a simulated basal face was formed. This surface is not plane, but is composed of many small rounded areas, and is said by C. S. Hurlbut, Jr., of Harvard University, to resemble the similar surface on the few natural specimens of quartz which lack the completed pyramid.

The growth rate in terms of milligrams of silica transferred in oriented condition onto 1 cm²/day is another useful measure of success, although not free from complications due to changes in areas of different faces as the crystal grows.

The weight ratio of seed growth to supply loss × 100 may be called the per cent efficiency of the process and is a third useful yardstick. The silica leaving the supply has four possible destinations: (1) on the seed as desired, (2) on the walls of the chamber and on seed supports as a fine crystalline crust, (3) in chemical combination with the original solvent medium, and (4) in physical solution in the fluid phase.

The chemical and physical solution obtaining at elevated temperature yields at room temperature, when the contents of the autoclave are examined, a true solution of more or less complexity, a colloidal suspension which

[1] K. F. E. von Schafhäutl, 1845; for a complete account and bibliography of the subject see reference 4.

may also contain an amorphous precipitate, or one of these with a glass. If a glass be present, it must have been fluid at the temperature of the run, for the glass conforms to the bottom of the chamber and has a flat surface which is substantially horizontal. Such a condition, which implies two liquid phases co-existing at elevated temperature, was observed at the Naval Research Laboratory (*2*). In many of the runs made at the Brush Development Company the presence of a solid glass around chunks of undissolved silica implies that a dynamic condition has been arrested: the silica is on its way into solution, and a heavy concentration of alkaline and silicic components on the bottom results from the slowness of the diffusion.

Several kinds of silica are available from which to choose a supply to nourish the growing crystal. Quartz and vitreous silica are of particular interest, since quartz is the stable crystalline form at room temperature, whereas vitreous silica is the undercooled fluid. From the relative latent heats of fusion of quartz and cristobalite (3.1 and 1.0 kcal/mol, respectively) (*7*) a modification of Clapeyron's equation[2] demonstrates that the relative solubility at the same temperature should be of the order of magnitude of 1: 22, and vitreous silica, having a higher degree of instability at room temperature than cristobalite, should show a still higher solubility. Nacken, as reported in documents referred to previously, found the solubility of the vitreous form to be about 10-fold that of quartz, the solvent being water under its own vapor pressure at about 360° C.

This difference in solubility makes the isothermal technique attractive, and Nacken and others (e.g. *1*, *10*) have experimented with it. The vitreous silica goes into solution at its own surface; oriented silica molecules deposit on the surface of the crystal. The difficulties of arranging special thermal conditions or slow evaporation do not have to be considered.

Vitreous silica in hot alkaline solution has the bad habit—from the experimenter's point of view—of devitrifying unless it can go completely into solution. This long-known phenomenon (*6*) has been especially puzzling, since the end-product has been reported at different times as cristobalite and as quartz (*10*). The alteration of form, and therefore of solubility, adds complexity to the isothermal growing system, and the high solubility carries with it the danger that the solution may become so supersaturated with respect to the crystalline quartz that it lies in the "labile state" (*5*, *9*), in which event microscopic bits of solid impurities or microscopic sharp edges on the walls of the vessel and elsewhere act as nuclei upon which quartz will begin to deposit.

The controlled growing of quartz may be expected to yield economies of time and material in the process of converting crystals into oscillator-plate blanks. Grade I quartz crystals are always a small percentage of the weight taken from the mines because of the prevalence of flaws and inclusions. A large cutting loss occurs because the clear stones are usually more or less twinned, optically or electrically or both, and the oscillator plates must be cut from an untwinning region. The use of untwinned seeds of specially chosen size and orientation is expected to yield synthetic crystals which can be cut into blanks with a reduction of the usual loss by about one-fifth.

[2] This is essentially the freezing-point relationship, rigorously true only for dilute solutions obeying Raoult's Law; for example, see reference *3*.

References

1. Fenner, C. N. *Amer. J. Sci.* (4th Ser.), 1913, **36**, 356; Van Praagh, G. *Geol. Mag.*, 1947, **84**, 98.
2. Friedman, I. Symposium on the Synthesis of Single Crystals, AAAS Meeting, Boston, December 1946.
3. Glasstone, S. *Textbook of physical chemistry.* New York: D. Van Nostrand, 1940. P. 733.
4. Kerr, Paul F., and Armstrong, Elizabeth. *Bull. geol. Soc.*, 1934, **54**, (Suppl. 1), 1–34.
5. McCabe, W. L. *In* Perry, J. H. *Chemical engineers' handbook.* New York: McGraw-Hill, 1941. P. 1772.
6. Sosman, R. *The properties of silica.* New York: Reinhold, 1927. P. 97 ff.
7. Sosman, R. *The properties of silica.* New York: Reinhold, 1927. P. 312.
8. Spezia, Giorgio. *Accad. Sci. Torino, Atti,* 1904–05, **40**, 232–240.
9. Tutton, A. E. H. *Crystallography and practical crystal measurements.* (Vol. I.) London: Macmillan, 1922. P. 21 ff.
10. Wooster, Nora, and Wooster, W. A. *Nature, Lond.*, 1946, **157**, 297.
11. ———. Office of Technical Services Reports, PB 6498, PB 18784, PB 28897, and others. Washington, D. C.: Department of Commerce.

Effect of Diethylstilbestrol on the Thyroid Glands of Chicks Receiving Thiouracil

Jean E. Selle and Raymond M. Selle

Occidental College, Los Angeles, California

Thiourea, thiouracil, and related compounds are known to inhibit the secretion of thyroxin. Then, in response to the thyrotropic hormone of the anterior pituitary gland, the thyroid gland becomes hypertrophied and hyperplastic (*1*, *3*, *4*). Studies with radioactive iodine have shown that thiouracil prevents the thyroid gland from utilizing iodine to form thyroxin (*2*). The lighter-weight breeds of chickens, such as the Leghorns, give a greater thyroid response to thiouracil than do the heavier breeds, and the females of several varieties (Buff Minorcas, White Leghorns, New Hampshire Reds, and Buff Orpingtons) develop much larger thyroids than do the males (*4*).

This sex difference in the response of the male and female thyroid gland to thiouracil suggested the possibility that a gonadotropic hormone might influence the effects of the drug. For this purpose the synthetic estrogen-like hormone, diethylstilbestrol, was used.

Sixty one-week-old New Hampshire Red chicks were divided into four groups of 15 chicks each: Group C was the control group; Group S received stilbestrol; Group T received thiouracil; and Group TS received both thiouracil and stilbestrol. The chicks were kept in the same brooder and fed a 16% protein growing mash. The

drugs were given orally in pill form with the help of a little water from a medicine dropper whenever it was necessary to aid the chick in swallowing. The thiouracil was administered every day in a dosage of a .1-gm pill. When the body weight attained 100 gm, the dosage was increased by an additional .1 gm for each additional 100 gm of body weight. The stilbestrol was given every fourth day in .1-mg pills, and the dosage was increased in amount by .1 mg for each 100-gm increase in body weight.

The chickens were autopsied on the 23rd, 43rd, and 81st days of the experiment. Medication was stopped on the 43rd day; therefore, the birds that were autopsied on the 81st day had received the drugs for a period of 43 days, which was then followed by 38 days of recovery.

Fig. 1 shows the growth curves of the four groups of males and females. The chickens in the two groups receiving thiouracil and thiouracil plus stilbestrol ate less food, were much lighter in body weight, drank a great deal more water, had fewer and lighter-colored feathers, and were much more difficult to recognize as to their sex than the control and stilbestrol groups. In both the females and males, those receiving thiouracil and thiouracil plus stilbestrol made a marked increase in growth following the 7th week, when the drugs were discontinued.

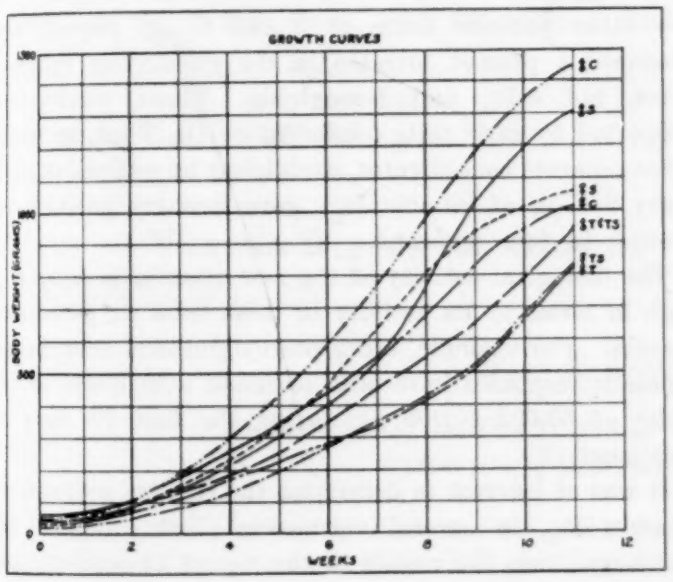


FIG. 1

Table 1 makes a comparison between control and experimental groups for both females and males on the three different days of autopsy. In each case the average weights of the thyroid glands in grams/kilogram of average body weight of the controls is taken as the standard for comparison. Thus, for the females (upper half of Table 1), on the 23rd day the weight of the thyroid glands/kilogram of body weight of the thiouracil-fed animals was 1.16 times that of the controls, and the ratio for the thiouracil plus stilbestrol group was 3.80 times that of the controls. On the 43rd day the thyroids of the T and the TS groups were 10 and 9 times heavier, respectively, than those of the control females. The third column (43 days of medication and 38 days of recovery) shows that the ratio of the weights of the thyroid glands to the body weight was 4.47 for the T group and 2.7 for the TS group, compared with the controls. This suggests a greater recovery in the females when stilbestrol is administered along with the thiouracil than when thiouracil is given alone.

TABLE 1

Ratio of ♀ thyroids (gm/1,000 gm of body weight)

	23 days	43 days	81 days (43 + 38)
Controls	1.0	1.0	1.0
Stilbestrol ...	0.65	0.9	1.03
Thiouracil ...	1.16	10.0	4.47
Thiouracil & Stilbestrol .	3.80	9.0	2.70

Ratio of ♂ thyroids (gm/1,000 gm of body weight)

	23 days	43 days	81 days (43 + 38)
Controls	1.0	1.0	1.0
Stilbestrol ...	1.1	1.5	1.5
Thiouracil ...	3.6	16.0	1.4
Thiouracil & Stilbestrol .	7.2	15.0	1.4

The lower half of Table 1 makes similar comparisons for the males. It should be noted that on the 81st day the experimental males showed a complete return to the normal ratio of grams of thyroid/kilograms of body weight.

We are unable to account for the observation that the ratio of the weight of the thyroids to body weight in the chicks receiving the stilbestrol with thiouracil were, on the 23rd day, three times as heavy in the females and twice as heavy in the males as in those which received thiouracil alone—especially so, since the relative weights of the thyroids of the animals receiving stilbestrol alone were in all cases approximately the same as those for the controls (*i.e.* 0.65, 0.9, and 1.03 for the females; and 1.1, 1.5, and 1.5 for the males).

Administration of diethylstilbestrol to chicks that received thiouracil for 43 consecutive days had no effect upon the weight of the thyroids/kilogram of body weight. Following the withdrawal of the thiouracil, either with or without stilbestrol, the males recovered completely. In the females there was a lag in the recovery from the effects of the thiouracil, and those that had received stilbestrol in addition showed a slightly greater recovery than those that had not.

References

1. Astwood, E. B., Sullivan, J., Bissell, Adele, and Tyslowitz, R. *Endocrinology*, 1943, **32**, 210.
2. Larson, R. A., Keating, F. R., Jr., Peacock, Wendell, and Rawson, R. W. *Endocrinology*, 1945, **36**, 160.
3. MacKenzie, C. G., and MacKenzie, J. B. *Endocrinology*, 1943, **32**, 185.
4. Mixner, J. P., Reineke, E. P., and Turner, C. W. *Endocrinology*, 1945, **34**, 168.

Crystalline Vitamin B_{12}

EDWARD L. RICKES, NORMAN G. BRINK, FRANK R. KONIUSZY, THOMAS R. WOOD, and KARL FOLKERS

Research Laboratories, Merck & Co., Inc., Rahway, New Jersey

A crystalline compound which in microgram quantities has produced positive hematological responses in initial tests in patients with addisonian pernicious anemia has been isolated from liver.

The effectiveness of liver as a specific agent in the dietary treatment of pernicious anemia was described by Minot and Murphy in 1926 (*2*). After this discovery, many investigations were carried out upon the purification of the principle (or principles) in liver responsible for its therapeutic effectiveness. One of the difficulties in the development of purification methods was the lack of a sufficient number of available pernicious anemia patients for the testing of fractions resulting from purification attempts. Although many efforts have been made to develop a biological assay, no method has been described which has been definitely successful in guiding the fractionation work.

TABLE 1

APPROXIMATE VITAMIN B_{12} CONTENTS OF COMMERCIAL LIVER EXTRACTS FOR PARENTERAL USE
(15 U.S.P. injectable units/ml)

Source	Vitamin B_{12} content (microbiological assay)			
	LLD units/ml	μg/ml	μg/U.S.P. unit	Per cent of dry weight
Company A	72,000	6.5	0.4	0.003
Company B				
(Sample 1)	13,000	1.2	0.1	0.00055
(" 2)	19,000	1.7	0.1	.....
Company C				
(Sample 1)	154,000	14.0	0.9	0.014
(" 2)	80,000	8.0	0.5	0.0065
Company D				
(Sample 1)	29,000	2.6	0.2	0.001
(" 2)	39,000	3.5	0.2	0.0014

Commercial liver preparations, which are crude concentrates of the active principle, have been available for medical use for some time. The activity of these preparations is standardized by clinical tests.

Research in these laboratories in 1942, together with collaborative clinical tests conducted by Randolph West,[1] showed that further purification of the "anti-pernicious anemia" principle in commercial liver concentrates could be effected. Subsequently, these chemical and clinical studies were extended, and more recently Mary S. Shorb and George M. Briggs[2] collaboratively tested certain clinically highly active fractions for growth activity for *Lactobacillus lactis* Dorner and found them to be microbiologically active. This microorganism was found by Dr. Shorb to require two unidentified growth factors (*3*); one of them (LLD factor) appeared to be related to the activity of commercial liver preparations used in the treatment of pernicious anemia. For convenience in the testing of the fractions, use was made of an arbitrarily selected standard liver concentrate which was assigned a potency of 1,000 LLD units/mg.

Further purification of clinically active liver fractions[3] has led to the isolation, in minute amounts, of a crystalline compound which is highly active for the growth of *L. lactis*. This compound is being called vitamin B_{12}.[4] Its potency is about 11,000,000 LLD units/mg, and 0.000013 μg/ml of culture medium is capable of supporting half-maximal growth under the conditions used. This potency value was found by Dr. Shorb (*4*), using a 23-hr growth period. The compound crystallizes in the form of small red needles which, after drying, showed refractive indices of α, 1.616; β, 1.652; and γ, 1.664.[5] On the micro-stage, the crystals darken to black at about 210–220°, but do not liquefy below 300°.

Randolph West (*5*) has tested this crystalline compound for activity in the clinical treatment of pernicious anemia in relapse. In one patient a single intramuscular dose of 150 μg gave a very strong hematopoietic response; in two other patients doses of 3 and 6 μg, respectively, produced a prompt increase in the circulating reticulocytes, red cells, and hemoglobin. These results are supported by early tests conducted by Dr. West, in which three separate concentrates, containing by microbiological assay 2–5 μg of vitamin B_{12}, gave strongly positive responses in four patients.

The biological activity of the new vitamin is extremely high in terms of its activity in these tests on pernicious anemia. For example, using pteroylglutamic acid, hematopoietic responses have been obtained with doses of the order of 20,000–50,000 μg during the first 10 days of treatment (*1*).

It was of interest to determine the relative contents of vitamin B_{12} in several commercial liver extracts for parenteral use; the results of the assays are summarized in Table 1.

[1] Columbia University, College of Physicians and Surgeons.

[2] Department of Poultry Husbandry, Agricultural Experiment Station, University of Maryland. Dr. Briggs is now at the University of Minnesota.

[3] We are indebted to Dr. Shorb for many of the initial assays. We are also indebted to Miss Muriel Caswell and her colleagues of the Merck laboratories for microbiological assays.

[4] The reasons for this designation are as follows: The long expression "anti-pernicious anemia principle" is not advisable, largely because the biological role of this new compound in the treatment of pernicious anemia or other disease is yet to be learned. The term "LLD factor" implies a biological limitation and was used originally to name an activity. The biological activities of crude materials are frequently found later to be due to several chemically related entities, as exemplified in the vitamin and antibiotic fields. A trivial name based upon source or activity is undesirable. The name vitamin B_{12} has not been used in the B series and connotes only nutritional significance. We may in the future wish to designate a name based upon chemical structure.

[5] We wish to thank Charles Rosenblum and his associates for the determination of the optical properties.

One U.S.P. unit is defined (*6*) as that amount of liver extract required daily to produce satisfactory clinical and hematological responses in addisonian pernicious anemia. If it is assumed that this new crystalline compound is the only substance present in these preparations which is therapeutically active,[6] it is evident that clinical response should be obtained from the parenteral administration of approximately 1 μg of the new vitamin/day. The clinical responses obtained with single 3- and 6-μg doses of crystalline vitamin B_{12} are not inconsistent with the approximate equivalence of 1 μg of the vitamin and 1 U.S.P. injectable unit. It should be pointed out, however, that it is customary to administer 20–60 U.S.P. units of liver extract during the first two or three days to start remission of pernicious anemia in relapse. This dose range is equivalent to not more than about 20–60 μg of vitamin B_{12}.

Further research is in progress on the composition, structure, and biological activity of vitamin B_{12}.

During this research, we have had the pleasure and benefit of the interest and advice of Henry D. Dakin.

References

1. Doan, C. A., Wilson, H. E., and Wright, C.-S. *Ohio St. med. J.*, **1946**, **42**, 139; Hall, B. E., and Watkins, C. H. *J. lab. clin. Med.*, 1947, **32**, 622.
2. Minot, G. R., and Murphy, W. P. *J. A. M. A.*, 1926, **87**, 470.
3. Shorb, M. S. *J. biol. Chem.*, 1947, **169**, 455; *J. Bact.*, 1947, **53**, 669.
4. Shorb, M. S. *Science*, 1948, **107**, 397.
5. West, R. *Science*, 1948, **107**, 398.
6. ———. *U. S. P.*, **XIII**, 618.

Activity of Vitamin B_{12} for the Growth of *Lactobacillus lactis*[1]

Mary S. Shorb

Department of Poultry Husbandry, University of Maryland

A factor (LLD) required by *Lactobacillus lactis* Dorner was found (*3*) in refined liver extracts in concentrations bearing an almost linear relationship to the unit potency of the extracts used in the treatment of pernicious anemia. It was suggested that the LLD factor might be the therapeutically active principle in these extracts. A crystalline compound, vitamin B_{12}, has been isolated from liver (*1*) and has been shown to be highly active hematopoietically in initial tests upon cases of pernicious anemia (*4*).

Vitamin B_{12} has been assayed for LLD activity by essentially the method reported previously (*3*). The growth-promoting effect of crystalline vitamin B_{12} has been compared with that of a liver concentrate used as an arbitrary standard[2] for the LLD factor assay. The standard was assigned a potency of 1,000 units/mg. On this basis, the potency of vitamin B_{12} was found to be about 11,000,000 units/mg when a 23-hr growth period was employed and about 17,000,000 units/mg with a 42-hr growth period. These assay results illustrate the variation which may occur under varying test conditions. The conditions under which the culture is maintained may also affect the reproducibility of the assay values.

These results show that vitamin B_{12} is either wholly or partially responsible for the LLD growth activity observed for liver extracts. It is conceivable that two or more closely related principles may be present which are responsible for the activity observed. The multiple chemical nature of certain vitamins is now well known. The minute amount of this compound required for growth places vitamin B_{12} among the most potent microbiologically active compounds.

The liver concentrate standard is free from the other factor, TJ, required by *L. lactis*, at levels as high as 500 μg/tube. *L. casei, L. fermenti, L. arabinosus, Streptococcus faecalis* R, and *Escherichia coli* grow readily on the amino acid medium without supplementation with tomato juice. The addition of the liver concentrate, as a source of LLD factor, has little or no effect on their growth. The TJ factor(s) has been found to be synthesized by *E. coli, L. arabinosus, L. casei, L. fermenti,* and *Str. faecalis* R when they are grown on the amino acid medium.

Tests have been made for the presence of the LLD and TJ factor activities in those source materials and fractions derived therefrom which have been reported to contain unidentified factors for chicken nutrition (*2*). The LLD factor activity occurs in fairly high amounts, in approximately decreasing order, in a papain digest of acid precipitate from cow manure,[3] the acid precipitate from cow manure,[3] fish meal, pancreatin, papain, egg white, egg yolk, and in lower amounts in alcoholic extract of whey, potassium permanganate-oxidized alcoholic extract of whey, soybean oil meal, gelatin, zein and Mylase P. enzyme. The TJ factor activity is also found, in approximately decreasing order, in the papain digest of acid precipitate from cow manure, the acid precipitate of cow manure, egg yolk, papain, and pancreatin, but in much lower amounts in fish meal, alcoholic extract of whey, soybean oil meal, crude casein, egg white, zein, Mylase P. enzyme, potassium permanganate-oxidized alcoholic extract of whey, and gelatin. The distribution of

[1] Scientific Paper No. A198, Contribution No. 2113 of the Maryland Agricultural Experiment Station. This study was supported by a grant from Merck & Co., Inc., Rahway, New Jersey. The author is indebted to George M. Briggs for many valuable suggestions in connection with this study and to Margaret Karitas for technical assistance.

[6] The commercial liver preparations listed in the table were found to contain the equivalent of from 0.7 to 10.6 μg/ml of pteroylglutamic acid, as measured by chicken pancreas conjugase digestion followed by *L. casei* assay, using pteroylglutamic acid as the standard.

[2] This liver concentrate standard and the crystalline vitamin B_{12} were supplied by Merck & Co., Inc., during collaborative studies.

[3] The acid precipitate and the papain digest of the acid precipitate from cow manure were kindly supplied by H. R. Bird, Bureau of Animal Industry, U. S. Department of Agriculture, Beltsville, Maryland.

the LLD and TJ factor activities in these materials suggests that they may be involved in chicken nutrition.

References

1. Rickes, E. L., Brink, N. G., Koniuszy, F. R., Wood, T. R., and Folkers, K. *Science*, 1948, **107**, 396.
2. Rubin, M., and Bird, H. R. *J. biol. Chem.*, 1946, **163**, 393.
3. Shorb, M. S. *J. biol. Chem.*, 1947, **169**, 455.
4. West, R. *Science*, 1948, **107**, 398.

Activity of Vitamin B_{12} in Addisonian Pernicious Anemia

Randolph West

Department of Medicine, Columbia University, College of Physicians and Surgeons, Presbyterian Hospital, New York City

Crystalline vitamin B_{12} has shown positive hematological activity in three cases of addisonian pernicious anemia.

Collaborative clinical studies were begun in 1942 with chemical investigators in the Merck Research Laboratories on the further purification of liver concentrates which are effective in the treatment of pernicious anemia. Recently, a correlation was found between clinical activity and the activity of concentrates for the growth of *Lactobacillus lactis* Dorner. Shorb (*3*) has reported a relationship of the unit potency of liver extracts used in the treatment of pernicious anemia to a factor (LLD) required by *L. lactis*. These researches led to the isolation from liver of a crystalline compound designated vitamin B_{12} (*2*), which is very potent for the growth of *L. lactis* (*2, 4*). Vitamin B_{12} has produced a positive hematological response in three patients following single intramuscular injections of 3, 6, and 150 μg, respectively.

Four patients receiving single injections of impure amorphous concentrates containing 20,000–40,000 LLD units gave strong or maximal hematological responses, while three receiving 10,000 LLD units or less gave weak or negative responses.

Results from the last case receiving amorphous material and the three receiving crystalline vitamin B_{12} are summarized in Tables 1 and 2. One mg of crystalline vitamin B_{12} is equivalent to about 11×10^6 LLD units; 1 μg, to about 11,000 units.

TABLE 1

Amorphous Liver Concentrates

Case	*P.H. 88–58–92*						
Day	0	6	14	23	29	42	119
RBC × 10^6	1.7	...	2.4	2.6	2.8	3.3	4.5
Hgb (gm)	6.8	...	7.8	9.5	9.8	11.0	14.0
Reticulocytes (%)	2.4	20.0	1.5	1.0	13.6	1.1	...
LLD units	2×10^4			1.8×10^6			

Case 88–58–92 went home on the 45th day and has received no treatment aside from that recorded. Case 9178–48 had eaten some liver before entering the hospital and had a reticulocyte count of 8% a week before day 0, by which time the count had fallen to 2.8%.

It is evident that there has been a rise in reticulocytes, red cell count, and hemoglobin, but it is still too early to say whether the blood picture will return to normal without further treatment in the last three cases. The rise in white count in case 9007 is striking; the platelets have risen from 120,000 to 340,000 in case 9178–48.

TABLE 2

Crystalline Vitamin B_{12}

Case	*Kings County 9007*				*Bellevue 8900–48*			*Bellevue 9178–48*			
Day	0	5	14	23	0	5	14	0	5	9	15
RBC × 10^6	1.5	...	2.6	3.4	1.5	...	2.6	1.4	...	...	2.6
Hgb (gm)	4.5	...	7.0	9.0	7.8	...	10.0	6.8	...	...	9.8
Reticulocytes (%)	0.5	27.0	2.0	0.5	2.8	26.0	3.1	2.8	10.2	4.0	2.6
Hct (%)	14.0	...	25.0	29.0	17.0	...	31	17	...	...	31
WBC × 10^3	9.0	25.0	9.0	...	2.3	...	5.8	4.2	...	...	8.1
Vitamin B_{12} (μg)	150	...	...	...	6	...	...	3	...	50	...
LLD units	1.6×10^6				6.6×10^4			3.3×10^4		5.5×10^5	

It is of interest that Preparation #31 of Dakin, Ungley, and West (*1*), which was clinically positive in 1936, has been shown by the microbiological assay to contain about 30,000 LLD units (3 μg B_{12})/25 mg, the dose used at that time.

Our thanks are due to Paul Reznikoff, William Dock, Dickson W. Richards, Francis Blake, W. B. Castle, and E. H. Reisner, Jr., who have received material from this group for clinical trial.

References

1. Dakin, H. D., Ungley, C. C., and West, R. *J. biol. Chem.*, 1936, **115**, 771.
2. Rickes, E. L., Brink, N. G., Koniuszy, F. R., Wood, T. R., and Folkers, K. *Science*, 1948, **107**, 396.
3. Shorb, M. S. *J. biol. Chem.*, 1947, **169**, 455; *J. Bact.*, 1947, **53**, 669.
4. Shorb, M. S. *Science*, 1948, **107**, 397.

IN THE LABORATORY

Stabilization of Prothrombin Activity by Freezing: Application to the Standardization of Prothrombin Determinations

ALEXANDER RANDALL, IV, and J. PERLINGIERO RANDALL

Department of Pediatrics, University of Pennsylvania Medical School

A review of the literature shows that many reports have appeared describing the loss of prothrombin activity in stored plasma. This loss is thought to be due to alteration of the fibrinogen (*5, 8*), the prothrombin (*7, 10*), or factors activating prothrombin (*2, 6, 9, 12, 13*). Deterioration is delayed, but not prevented, by storage of plasma at low temperatures (*7, 10, 12*). This deterioration is troublesome in that it complicates the clinical use of the one-stage test. Furthermore, it prevents the use of a control plasma of known activity for standardization of thromboplastin solution beyond a single day. Careful standardization requires the testing of four or more normal subjects each day. It was mainly for the purpose of avoiding this that a study was made of the feasibility of preserving prothrombin activity by freezing plasma. In the present report it is shown that storage without loss is possible and practical if certain precautions are taken.

Prothrombin times of various plasmas were determined, using the Quick method (*11, 14*). Nine ml of blood was drawn into a syringe containing 1 ml of 0.1 M sodium oxalate. This was mixed and centrifuged, and the separated plasma treated as described below. Rabbit brain thromboplastin (Bacto Thromboplastin, Difco) was used throughout the study, and this preparation showed the uniform qualities described by other authors (*3, 4*). The thromboplastin solution was prepared as described by Campbell (*1*). A fresh solution was used each day. All determinations were made in a glass-walled water bath at 37° C. This permitted observations of clotting without removing the solutions from the bath, thereby obviating effects due to temperature change.

In several instances plasmas to be tested were examined at different dilutions. These were made using 0.9% sodium chloride solution, and the concentration expressed as per cent plasma in salt solution.

Plasma samples to be preserved were placed in glass tubes of 3-mm internal diameter and sealed in a flame. A tube of convenient length held 0.5 ml of plasma, or enough for several determinations. These tubes were placed in an ordinary "deep freeze" unit at −20° C. Freezing took place within an hour, and the samples were kept frozen until thawed for testing. The plasma was thawed rapidly by placing the tubes in a beaker of water at 37–40° C. Tests were made without delay, the thawed plasma being kept in ice water until examined.

The values given in the tables represent the mean of at least two determinations, further measurements being made in the event that the first pair were not in good agreement.

Three series of experiments were carried out. In the first (Table 1), fresh plasmas were divided into two portions. One of these was tested immediately, and the other was stored. After the time indicated in the table, the stored specimen was thawed and the prothrombin time again measured. At the same time a fresh specimen, drawn from the same subject, was also tested. Values in the table refer only to the 50% dilution, but agree with values obtained at 25% and 10% on the same subjects. It is to be noted that one specimen in this series was kept 50 days without change in activity.

TABLE 1

Date determined (1946)	50% Plasma prothrombin time (sec)			
	Days stored	Fresh sample	Stored sample	Fresh sample
Nov. 25	..	26	...	...
Dec. 2	7	...	26	25.5
Nov. 26	..	25.5	...	...
Dec. 5	9	...	25	25
Nov. 26	..	25.5	...	...
Dec. 3	7	...	26.5	...
Oct. 15	..	32	...	...
Dec. 3	50	...	31.5	...

In a second experiment (Table 2) blood specimens from the same subject were collected and stored on each of 5 successive days. Eight days after collecting the last specimen, prothrombin times of all stored specimens were measured. A fresh specimen was tested at the same time. Although results are given only for the 50% dilution, determinations at 25% and 15% gave similar agreement. It will be noted that deviation from the mean was no greater than 5%.

TABLE 2

Date drawn (1947)	Jan. 23	Jan. 24	Jan. 25	Jan. 26	Jan. 27	Feb. 5
Days stored	13	12	11	10	9	Fresh
Prothrombin time (sec), 50% plasma on Feb. 5, 1947	22.5	25	22	22.5	23	24

Finally, a series of 8 specimens from different subjects were obtained. The plasma from each was divided into three portions. One portion was tested immediately, and the others were frozen and stored. Eight days later the second portion of each was thawed and the prothrombin activity measured. This process was repeated after a further period of 13 days, when the third portion was examined. The results for the undiluted plasma, given in Table 3, show agreement with those obtained at 25% dilution. It will be noted that there are only minor differences in the average values. Fresh control plasmas studied at the time of each determination showed no significant differences in the thromboplastin solutions used.

TABLE 3

Subject	Prothrombin time (sec)—undiluted plasma		
	Fresh	Stored 8 days	Stored 22 days
A	16.5	17	16.2
B	16.1	15.2	16.3
C	19.3	19.8	19.1
D	18.9	19	18.8
E	19.1	18.3	18.5
F	19.7	19.1	18.9
G	20.6	20.2	...
H	19.7	19.5	...
Average	18.7	18.5	18.0

The first attempts to store plasma by freezing were only partially successful. Evaluation of a number of techniques led to the method finally devised. Four important points in this technique require emphasis:

(1) The samples were kept frozen. Samples accidentally thawed during storage showed a considerable prolongation of the prothrombin time. Freezing in an ordinary "deep freeze" unit was quite satisfactory, and no improvement was noted when samples were rapidly frozen by means of solid carbon dioxide.

(2) Samples to be used in determinations were always thawed rapidly. If allowed to thaw in ice water or in air at room temperature, a faint cloud of precipitated material was often observed in the plasma, and this was usually accompanied by an increase in the prothrombin time. This may be associated with the fibrinogen change reported by others (*5, 8*). Such phenomena were not observed with rapidly thawed plasma.

(3) Once thawed, determinations were made without delay. Thawed plasma kept at room temperature or at 37° C deteriorated rapidly, the prothrombin time being doubled in 1½ hrs at the latter temperature. Such changes were noted to be similar to those described by others (*7, 10*) for fresh plasma, but were found to be more pronounced in thawed plasma. Fortunately, when thawed plasma samples were kept in ice water during the period between thawing and determination, no appreciable deterioration occurred for at least 4 hrs.

(4) Storage was most satisfactory when tubes of small lumen were used. The more rapid heat transfer of such tubes presumably aided the necessary rapid thawing of the plasma. The tubes used were easily sealed in a flame, thereby avoiding spillage and loss or contamination. No precautions were taken to avoid bacterial contamination, aside from ordinary cleanliness.

It might also be noted that much of the work was done during hot weather and that this did not demonstrably influence the results.

It is believed that the method described makes possible (1) the use of stored standard plasma samples as controls in the prothrombin test, and (2) storage of plasmas, if desired, until a convenient time for determination is at hand.

References

1. Campbell, H. A., Smith, W. K., Roberts, W. L., and Link, K. P. *J. biol. Chem.*, 1941, **138**, 1.
2. Honorato, R. *Amer. J. Physiol.*, 1947, **150**, 381; Honorato, R., and Quick, A. J. *Amer. J. Physiol.*, 1947, **150**, 405.
3. Hurn, M., Barker, N. W., and Magath, T. B. *J. lab. clin. Med.*, 1945, **30**, 432.
4. Kato, K., Poncher, H. G., and Ricewasser, J. C. *Amer. J. clin. Path.* (Tech. Suppl.), 1941, **5**, 110.
5. Loomis, E. C., and Seegers, W. H. *Amer. J. Physiol.*, 1947, **148**, 563.
6. Mann, F. D., Hurn, M., and Magath, T. B. *Proc. Soc. exp. Biol. Med.*, 1947, **66**, 33.
7. Martin, J. W., Curfman, G. H., and Cavano, F. L. *J. lab. clin. Med.*, 1947, **32**, 554.
8. Morrison, I. R. *Amer. J. med. Sci.*, 1946, **211**, 325.
9. Munro, M. P., and Munro, F. L. *Amer. J. Physiol.*, 1947, **150**, 409.
10. Page, R. C., and DeBeer, E. J. *Amer. J. med. Sci.*, 1943, **205**, 257.
11. Quick, A. J. *J.A.M.A.*, 1938, **110**, 1658.
12. Quick, A. J. *Amer. J. Physiol.*, 1943, **140**, 212.
13. Quick, A. J. *Amer. J. Physiol.*, 1947, **151**, 63.
14. Quick, A. J., Stanley-Brown, M., and Bancroft, F. W. *Amer. J. med. Sci.*, 1935, **190**, 501.

An Improved Method of Precipitating and Drying Vinyl Copolymers[1]

Harold Werbin[2]

High Polymer Bureau,
Polytechnic Institute of Brooklyn

In the course of synthesizing several 1-kg batches of vinyl copolymers there arose the problem of precipitating and drying the large batches in the laboratory.

For most of the copolymers prepared, precipitation in a large vat with methanol gave rise to materials with a molasses-like consistency which were very difficult to dry. This method failed with a number of copolymers including methyl acrylate-maleic anhydride, ethyl acrylate-maleic anhydride, styrene-butyl acrylate (these copolymers were prepared in toluene solution), methyl vinyl ketone-methyl methacrylate, methyl vinyl ketone-butyl methacrylate (prepared in 70% methanol solution), vinyl acetate-vinyl

[1] The work described in this paper was done under a contract, recommended by the Bureau of Aeronautics, between the Navy Department and the Polytechnic Institute of Brooklyn.

[2] Senior research assistant, 1947–48.

chloride (bulk polymerization), vinyl ethyl ether-acrylonitrile, vinyl *n*-butyl ether-acrylonitrile, and vinyl isobutyl ether-acrylonitrile (prepared in acetone solution).

It seemed that the ideal conditions for precipitating and drying would be those wherein the copolymer would be precipitated with a large surface area, thus expediting complete solvent removal. For the acetone-soluble copolymers (those mentioned above), this was realized in the following manner: The copolymer solution was precipitated in four times its volume of methanol to remove the unreacted monomers. The methanol was then decanted and the copolymer taken up in acetone. The latter was added dropwise or in a very thin stream on a fast stream of water in the laboratory trough. The precipitated copolymer was caught on a screen placed at the end of the trough. This method of precipitation permitted complete removal of the acetone from the copolymer. The latter was then placed on paper toweling (without squeezing out the excess water) and dried for 48 hrs. After this time the copolymers were usually completely dry. If not, final drying was easily accomplished in a vacuum oven at 35° C.

Automatic Masking of Lantern Slides

D. Eugene Copeland

Arnold Biological Laboratory, Brown University

In this laboratory we have developed a method for the automatic masking of lantern slides which may prove useful to scientists in many fields. The procedure follows:

The negative is projected to a suitable size, either by enlargement or reduction, upon the easel shown in Fig. 1.

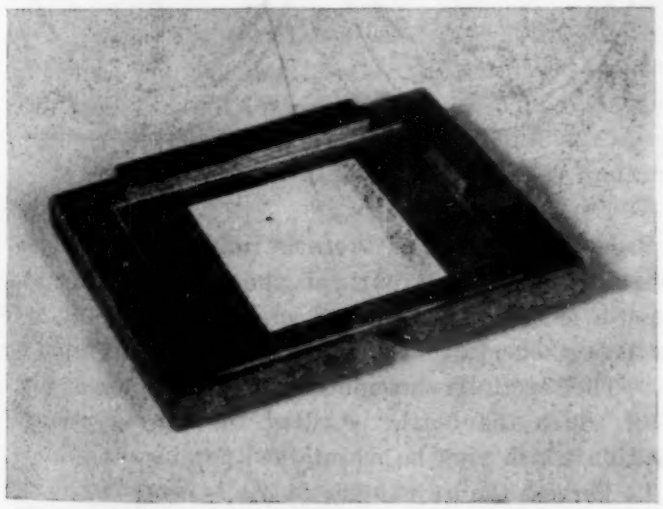


Fig. 1

On the easel is a lantern-slide cover glass, to the lower surface of which a square of white paper, backed with tin foil, has been glued. The subject material is focused and composed on the white paper.

A lantern-slide plate is then substituted and the exposure made in the usual manner. Before the plate is removed, the lantern-slide cover glass is placed on top of it with the tin foil in contact with the emulsion. After removing the negative carrier from the enlarger, the border about the tin foil is then "burned" by double or triple the original exposure time.

On development, there is revealed a lantern slide that has been accurately composed and automatically masked to that composure. Three sizes of composing and masking shields, all of which have 1-cm top and bottom borders cover the range of most subjects. The lateral borders are 1, 2, and 2.5 cm, respectively. Almost any variation is possible. It should be kept in mind, however, that the binding tape accounts for about 0.5 cm, and any masking should exceed that dimension, if for no other reason than to allow space for thumb markers.

A Simple Graphical Solution for Potency Calculations of Multidose Assays

Robert A. Harte

Research Laboratories,
The Arlington Chemical Company,
Yonkers, New York

The necessity for calculation of the results of a number of multidose assays led to search for a simple method of solution. In the tests to be evaluated, samples were assayed at two or three dose levels, conditions varied as to preliminary estimates of potency of unknown, but the number of replicates per sample and standard at each dose were constant in any one experiment. The data from each test could thus easily be handled by the method of Bliss and Marks (*1*), but application of this technic is both tedious and time consuming for routine purposes.

A survey of the literature reveals that Knudsen (*3*) has described a graphical method which might be adapted to the problem in hand. However, her approach is limited by the necessity of drawing a network of radial lines for each dose interval employed as well as for every different assumed potency, and the axes must be rescaled for responses of different orders of magnitude. The nomograph provided for estimation of the error of the assay may be used only where rational basis for grouping of replicates exists; and even if litter mates were used in these tests, there is doubt whether they provide such a basis (*2*).

Sherwood (*4*), on the other hand, has reduced the calculation of potency from such data to relatively simple formulas, and these lend themselves readily to rearrangement which permits simple graphical solution. In the following, the same meanings are to be supplied to the symbols as those described by Sherwood. The case of the two-dose assay will be given in detail; similar reasoning leads to corresponding simplification for the cases of three- and four-dose assays.

The solution of the two-dose assay, as given by Sherwood, is:

$$\% \text{ Potency} = \text{Antilog}\left[2 \pm c + d\frac{(U_2 + U_1) - (S_2 + S_1)}{(U_2 + S_2) - (U_1 + S_1)}\right]. \quad (1)$$

If the data are substituted in the fraction within the

brackets and calculated as a decimal, P_2, then (1) may be written as

$$\% \text{ Potency} = \text{Antilog } [(2 \pm c) + d\,P_2] \qquad (2)$$

or

$$\text{Log } (\% \text{ potency}) = (2 \pm c) + d\,P_2. \qquad (3)$$

From (3) it follows that a straight line on semilog paper satisfies the equation for any assigned values of c and d. The entire information in Knudsen's chart is thus reduced from a network of 50 radial lines to one line on a semilog plot at the expense of requiring the assayer to calculate a simple ratio.

The work of preparing new graphical solutions for other values of c and d is vastly simplified. Following Sherwood further, the equations for three- and four-dose assays reduce to

$$\text{Log } (\% \text{ Potency}) = (2 \pm c) + \frac{4}{3} d\,P_3 \text{ and} \qquad (4)$$

$$\text{Log } (\% \text{ Potency}) = (2 \pm c) + 5d\,P_4, \qquad (5)$$

where P_3 and P_4 are the decimal equivalents of the appropriate fractions. These functions are as susceptible to simple graphical representation as Equation 3.

A family of lines for different values of c, at constant d, has been constructed for routine use here, and the average time of calculation of potency has been reduced to a matter of 2–3 min by use of this chart. Comparison with results obtained by the method of Bliss and Marks shows agreement within the limits of error of the interpolation (less than 1%).

References

1. Bliss, C. I., and Marks, H. P. *Quart. J. Pharm. Pharmacol.*, 1939, **12**, 182–205.
2. Harte, R. A., Travers, J. J., and Sarich, P. *J. Nutrition*, 1947, **34**, 363–372.
3. Knudsen, L. F. *Science*, 1945, **101**, 46–48.
4. Sherwood, M. B. *Science*, 1947, **106**, 152–153.

A Method for Obtaining Massive Growth of Bacteria in Fluid Media

J. Howard Brown and Ronald M. Wood

Department of Bacteriology, School of Medicine, and Wilmer Ophthalmological Institute, Johns Hopkins Hospital and University

A method has been developed which has been found useful for the preparation of *Brucella* antigen and for the collection of a large amount of bacterial sediment for agglutinin absorption.

A thoroughly washed cellulose sponge of coarse texture is mounted in the upper part of a 250-ml centrifuge bottle. The sponge is so cut and mounted that a pipette may be passed through a central hole to the bottom of the bottle. The dry sponge is readily cut to size and shape by a sharp knife or the moist sponge by scissors. The hole may be cut by a cork borer. When moistened and wrung nearly dry, the sponge may be forced into and out of the neck of the bottle. A glass tube of sufficient diameter to pass a pipette passes through the sponge and rests on the bottom of the bottle, the sponge being supported at about 4 cm from the bottom by a bulb blown in the tubing (Fig. 2). The sponge may be cut square (about $35 \times 35 \times 55$ mm) or cylindrical, but of such diameter that, when wet, an air space remains between the sponge and the sides of the bottle. Other methods of suspending the sponge have been tried but with less satisfactory results (see Fig. 1).

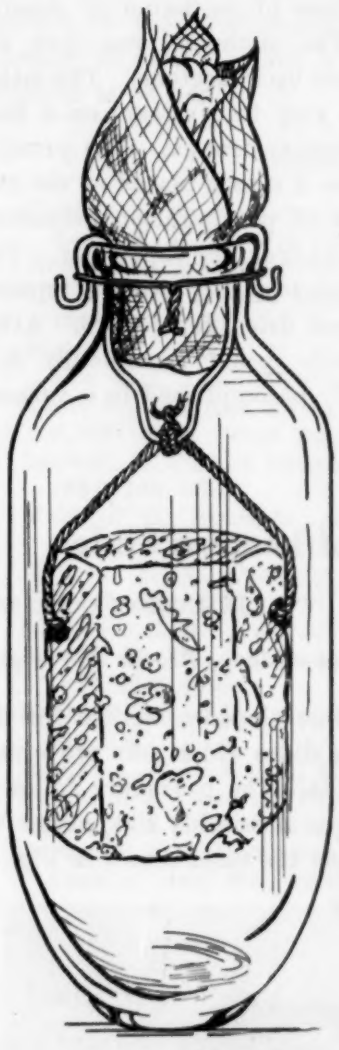


Fig. 1

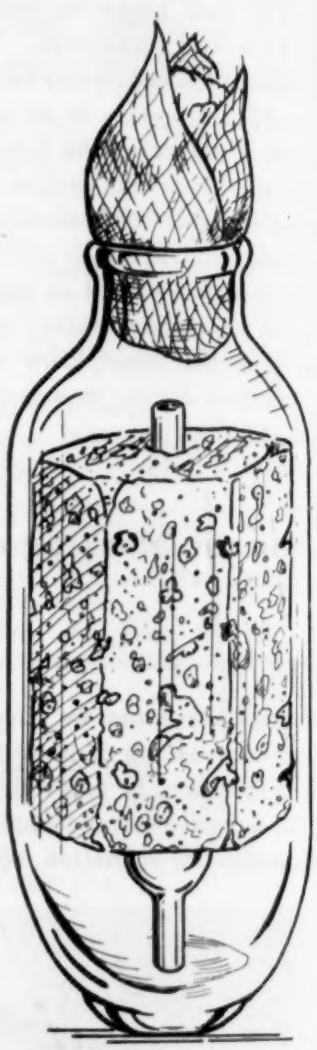


Fig. 2

From 30 to 40 ml of broth is run through the central tube into the lower part of the bottle. This should reach a level not less than 2 cm below the sponge. The bottle is then plugged and autoclaved in the usual manner. The broth is inoculated by means of a pipette, after which the bottle is tilted to wet the sponge—a position which may be maintained for incubation.

To harvest the growth the bottle is centrifuged at low speed (about 500 rpm) for 5 min. A greater yield of organisms may be obtained by rewetting the sponge and recentrifuging two or three times. The turbid broth is pipetted out, transferred to a small centrifuge tube, and centrifuged at high speed to throw the sediment down.

This method may be used for many purposes where a maximum growth surface exposure is desirable or where the use of agar is to be avoided. The yields from a given amount of broth have been several times greater than those from the same amount of broth in bottles without the sponge.

Book Reviews

Physical fitness appraisal and guidance. Thomas Kirk Cureton, Jr. St. Louis: C. V. Mosby, 1947. Pp. 566. (Illustrated.) $6.00.

This book represents an ambitious and laudable attempt, sponsored by the University of Illinois, to appraise physical fitness and to lay down principles for its improvement. A battery of fitness tests was applied to students entering the University's Colleges of Medicine, Dentistry, and Pharmacy. The techniques and results are presented, and the author, who administered the study, interprets the results and provides hints for the guidance of physical educators.

The study signifies a growing interest in fitness and health; the "Committee on Physical Fitness" that supported the study and encouraged the publication of results is to be congratulated. Since other universities are alert to the problem, *Physical fitness appraisal and guidance* may well stimulate interest in other quantitative studies designed to evaluate the author's new techniques.

It may be appropriate to refer to certain sections of Chapter 5, since these seem rather superficial. The author refers briefly to the major role played by excess fat deposition in lowering fitness and favoring degenerative disease. Convincing graphic evidence might well have been prepared from the morbidity records of insurance companies. Seven methods are recommended for reducing, but these do not include a clear statement of the basic principle: *caloric intake must be less than caloric output.* Further, the idea that sweating and reduced water intake modify fat deposition is, unfortunately, perpetuated. Finally, some readers will question the recommendations that the fat person should eat more bread and less dry cereal, more turkey and less cheese.

But these are minor points that can be corrected in later editions. The important fact is that the author has attempted to provide a basis for greater physical fitness and health. The crucibles of experience and of physiological research will determine the soundness of his approach.

DAVID B. DILL

Army Chemical Center, Maryland

Hearing aids: an experimental study of design objectives. Hallowell Davis, *et al.* Cambridge, Mass.: Harvard Univ. Press, 1947. Pp. viii + 197. $2.00.

With the development of the miniature vacuum tube and the crystal microphone in the late 1930s, pocket-size hearing aids of relatively wide frequency response and high fidelity became commercially available. In view of these technical advances, it became practicable as well as desirable to ask: "How nearly should the characteristics of the hearing aid compensate for the detailed deficiencies of the individual impairment?" The report under review proposes an answer to this problem.

To make the study, an instrument known as a "Master Hearing Aid" was constructed which could be set to give one of several patterns of frequency response and suitable limits of maximum acoustic output. Tests were then made on 18 hard-of-hearing listeners to determine the relative value of various frequency patterns. From the results obtained, the following tentative design objectives for hearing aids were drawn up: (1) a uniform frequency response, *i.e.* without marked resonant peaks or valleys, covering the range from 300 to 4,000 CPS with a tone control adjustment to give a flat or a moderately rising response; (2) a smoothly graded gain control approximately logarithmic over a 40-db range; (3) a choice of models, the lowest powered to have at least 40-db acoustic gain available, the highest powered a maximum of 80-db, with provision for limiting the maximum acoustic pressures by compression or peak clipping as required by, and as acceptable to, the wearer. The above recommendations were based on the conclusion that "regardless of the nature of their particular defect, most patients hear best with an instrument which amplifies all frequencies uniformly, or with moderate emphasis of the higher frequencies."

The term "most patients" leaves the few for whom some deviation from high fidelity must be provided for best results. The report does not cover this aspect of hearing aid "fitting." Further information on the scope of the problem undoubtedly would have been secured had the original plan of validating the laboratory studies by large-scale clinical testing been carried out. The challenge of recognizing and providing for this type of hard-of-hearing individual remains one of considerable significance to the designer, to the manufacturer, to the otologist, and to the hearing aid dealer.

In general, the conclusions reached in the Harvard study are substantiated by the recently published Report No. 261 of the British Medical Research Council.

MARK B. GARDNER

Bell Telephone Laboratories

The engrammes of psychiatry. J. M. Nielson and George N. Thompson. Springfield, Ill.: Charles C. Thomas, 1947. Pp. xix + 509. (Illustrated.) $6.75.

Included in this moderate-sized book is a careful, clearly expressed effort to relate the known facts of brain structure and function to behavior. The somewhat unfamiliar word "engramme" is used to emphasize a conviction that each pattern of personality function is controlled or produced by residual traces—engrammes—of events or inborn tendencies which remain in the brain on call in the service (or disservice) of the individual, and which are subject to various disruptions and other

disabilities. Thus, the "engramme" is in reality a construct erected to explain the facts of personality and behavior; it remains to be seen whether or not the utility of this concept will be greater than that of other concepts currently in use. It is affirmed that the brain is the organ of the mind, and that all psychology is cerebral physiology. Experimental work in neurology and neuropathological evidence bearing on such matters as conation, consciousness, perception, recognition, concept formation, and judgment are discussed in an easy-to-read manner. After laying this foundation the various clinical states are described and discussed largely from the point of view of the possible neuroanatomical and neurophysiological lesions involved in causation. Of interest especially are the chapters dealing with cerebral function with reduced awareness, mental disturbances due to cerebral neoplasm, and the chapter on mental symptoms due to general somatic diseases.

The authors' major interest in experimentally verified material may have outweighed the discussions of environmentally and psychodynamically determined aspects of mental disease, much of which cannot yet be examined experimentally. Occasional assertions of opinion, particularly on psychological and sociological points, are made in a manner that does not reflect the uncertainty of usually informed authorities, e.g. in the discussion of group differences in the chapter on personality. Problems of intensive psychotherapy such as the relationships between patient and therapist, the dealing with resistances, the planning of interviews, and much of symbology are treated lightly. Hereditary and constitutional factors are emphasized, as in the discussion of schizophrenia, to an extensive degree and at the expense of the discussion of those dynamic factors which have been found frequently vulnerable to attack by various psychotherapeutic methods.

An attractive feature of the text is the historical introduction to each new subject and the sense of perspective which the wide clinical experience of the authors gives. The case material is illuminating and of rich variation and interest.

WILLIAM T. LHAMON
Cornell University Medical College

Scientific Book Register

CLARK, W. MANSFIELD. *Topics in physical chemistry: a supplementary text for students of medicine.* Baltimore: Williams & Wilkins, 1948. Pp. xv + 738. (Illustrated.) $10.00.

DEAN, ROBERT B. *Modern colloids: an introduction to the physical chemistry of large molecules and small particles.* New York-Toronto-London: D. Van Nostrand, 1948. Pp. xi + 303. (Illustrated.) $3.75.

FAIRBROTHER, R. W. *A text-book of bacteriology.* (5th ed.) New York: Grune & Stratton, 1948. Pp. viii + 480. (Illustrated.) $6.00.

FOLLIS, RICHARD H., JR. *The pathology of nutritional disease; physiological and morphological changes which result from deficiencies of the essential elements, amino acids, vitamins, and fatty acids.* Springfield, Ill.: Charles C. Thomas, 1948. Pp. xii + 291. (Illustrated.) $6.75.

GREY, MARION. *Catalogue of type specimens of fishes in Chicago Natural History Museum.* (Fieldiana: Zoology, Vol. 32, No. 3.) Chicago: Chicago Natural History Museum, 1947. Pp. 109–205. (Illustrated.) $1.25.

KRANZ, LEON G. *Kinesiology laboratory manual.* St. Louis, Mo.: C. V. Mosby, 1948. Pp. 177. (Illustrated.) $2.75.

LEVINSON, SAMUEL A. (Ed.) *Symposium on medico-legal problems under the co-sponsorship of the Institute of Medicine of Chicago and the Chicago Bar Association.* Philadelphia-London-Montreal: J. B. Lippincott, 1948. Pp. xviii + 255.

LLAVERO, F. *Thromboendangiitis obliterans des Gehirns: neurologischpsychiatrische Syndrome.* Basel: Benno Schwabe, 1948. (Imported by Grune & Stratton.) Pp. 248. (Illustrated.) Fr. 24–.

MCNAIR, JAMES B. *The analysis of fermentation acids.* Los Angeles: Westernlore Press, 1947. Pp. 290. (Illustrated.) $7.50.

MENZEL, DONALD H. *Elementary manual of radio propagation.* New York: Prentice-Hall, 1948. Pp. xii + 222. (Illustrated.) $7.65.

PETERSEN, WILLIAM F. *Man, weather, and sun.* Springfield, Ill.: Charles C. Thomas, 1948. Pp. xxx + 463. (Illustrated.) $10.00.

PRICE, WILLIAM E. *Laboratory chemistry.* Yonkers-on-Hudson, N. Y.: World Book Co., 1947. Pp. x + 133. (Illustrated.)

REINDEL, F., and ANSCHÜTZ, LUDWIG. Richter-Anschütz. *The chemistry of the carbon compounds.* Vol. IV: *The heterocyclic compounds* and *Organic free radicals.* (Translated by M. F. Darken and A. J. Mee.) (3rd English ed. from 12th German ed.) New York: Elsevier, 1947. Pp. xv + 498.

SHERFF, EARL EDWARD. *Further studies in the genus, Dodonaea.* (Botanical Series, Vol. 23, No. 6.) Chicago: Field Museum of Natural History, 1947. Pp. 317. $.75.

SHERFF, EARL EDWARD. *A preliminary study in Hawaiian species of the genus Rauvolfia* and *Additions to the genera Scalesia and Hidalgoa.* (Botanical Series, Vol. 23, No. 7.) Chicago: Field Museum of Natural History, 1947. Pp. 321–336. (Illustrated.) $.25.

SHERRINGTON, SIR CHARLES. *The integrative action of the nervous system.* (6th ed.) New Haven, Conn.: Yale Univ. Press, 1948. Pp. xxiv + 433. (Illustrated.) $6.00.

VENABLE, WILLIAM MAYO. *The interpretation of spectra.* New York: Reinhold, 1948. Pp. v + 200. (Illustrated.) $6.00.